THE AEROPLANE and ASTRONAUTICS

AUGUST 19, 1960

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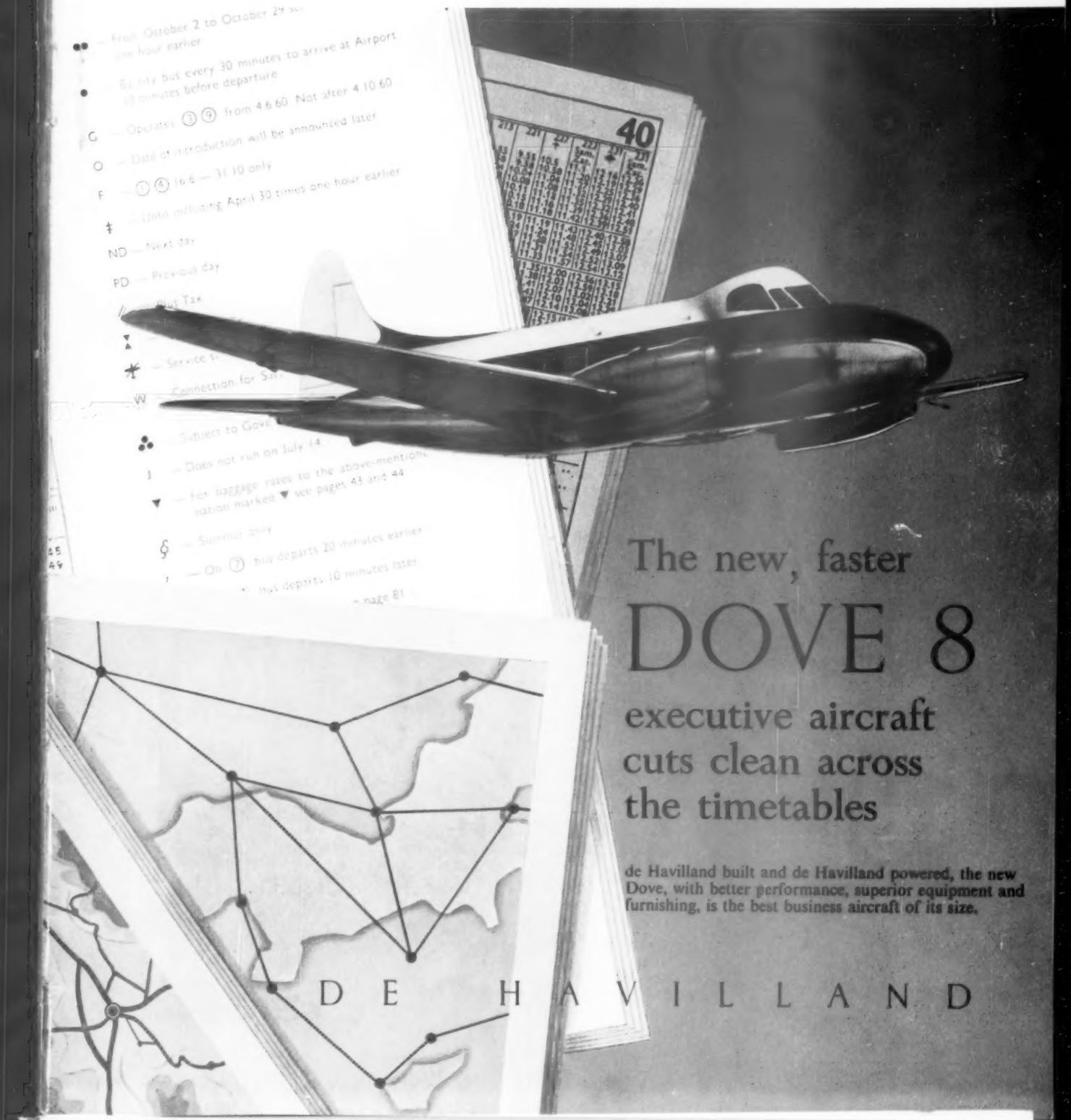
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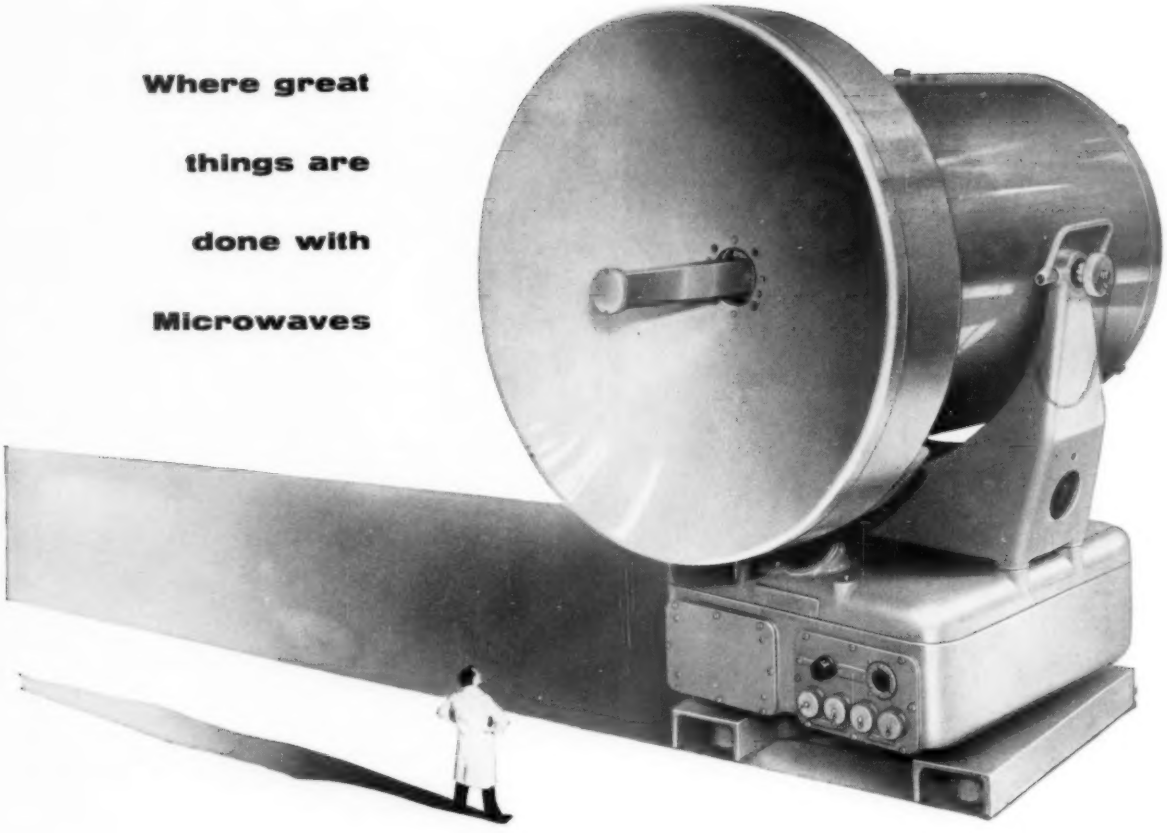

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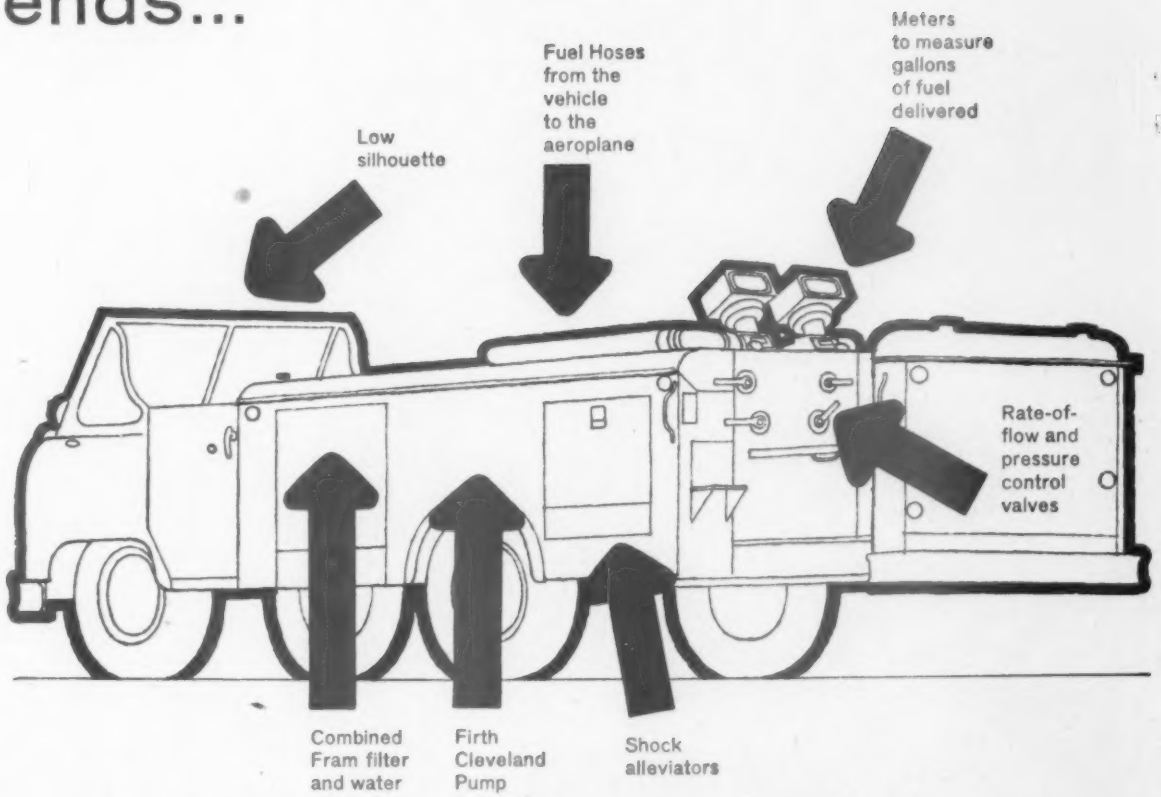
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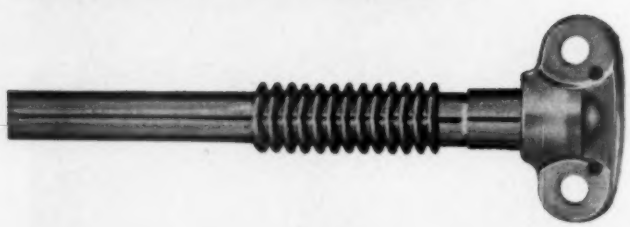

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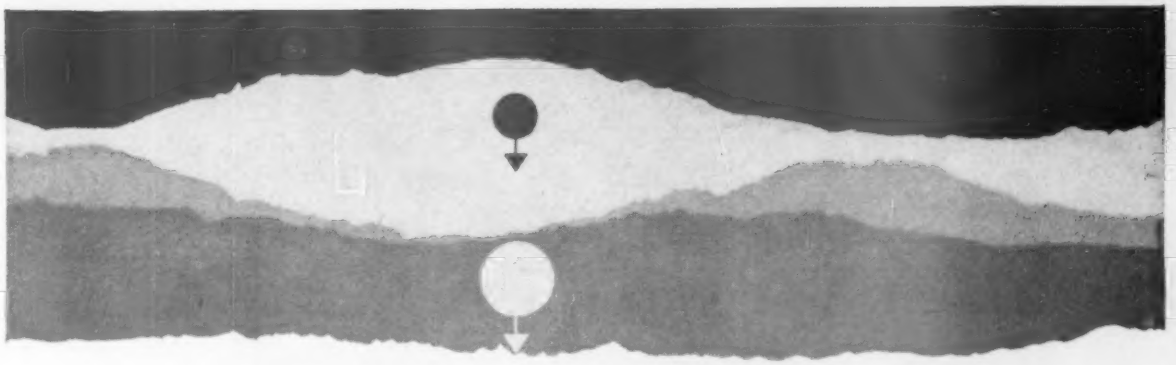

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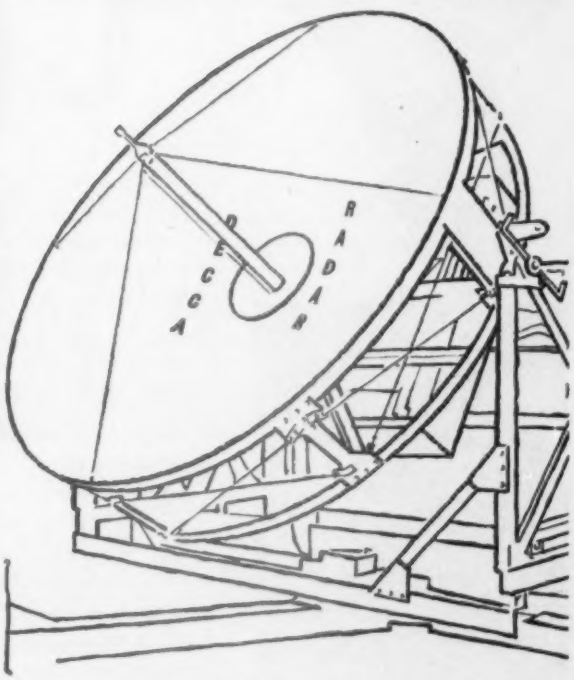

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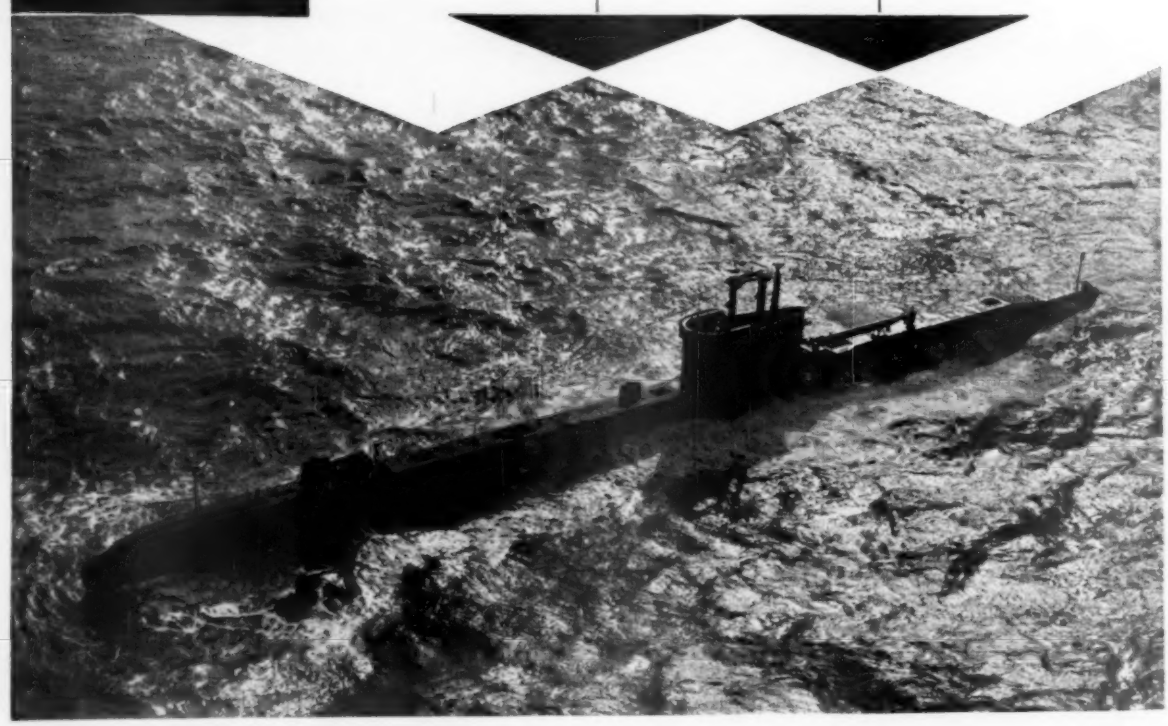

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THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2548 AUGUST 19, 1960

Kicking Against the Pricks

American and Russian space activities depend on military backing, either directly or indirectly; they also have tremendous military implications. One has only to think back to the effect of the impact of Lunik 2 with its target; Russian military long-range rocket capability has been taken much more seriously ever since. Man-in-space programmes, the return of data capsules or warheads from orbit, and the development of reconnaissance satellites are new military factors which must have marked effect upon the nuclear stalemate now reached in the cold war.

Any realistic British space programme must cost millions of pounds annually. The military value of such a programme will inevitably be a major factor in any decision for or against it. Yet many people take an ostrich-like attitude about this; military factors are usually neglected by those who argue the pros and cons of a British space programme.

Because of this military factor, the recent attacks by Prof. Fred Hoyle on a British space programme are wide of their mark. The grinding of particular axes rings loud through his arguments.

Briefly, Prof. Hoyle argues that the scientific importance of space research is in no way justified by the cost involved, and that work of much greater scientific importance could be done with a small fraction of the money needed for a space programme. He feels that the whole of British science would become lop-sided and distorted if the Government decided in favour of a space programme.

Prof. Hoyle is not alone in the scientific world in his views. But he ignores the fact that a space programme is not necessarily a programme of financial support purely for scientific research. This misconception has arisen because the current British programme, the launching of British instruments in an economy-size U.S. satellite, comes under Lord Hailsham, the Minister of Science.

* * *

In fact, a full-scale programme, rather than what amount to "marking-time" attempts at purely scientific work, would probably have to be run by a new body analogous to the Atomic Energy Authority. The A.E.A. consumes many millions of pounds annually; the exact amount is secret because of the military importance of much of its work. Prof. Hoyle does not compare Britain's relatively small expenditure on pure science with the annual budget of the Atomic Energy Authority. Naturally enough; the aims, objects and scope are not the same; it would be like comparing chalk with cheese.

The Government has no easy decision to make. The decision to lay down a space programme must appear a frightening one to take against all the pressures to reduce national spending. In times of peace, even cold-war peace such as we experience today, spending on military arms is never popular. Against such feeling and in face of much expressed lack of enthusiasm from scientists, the laying down of plans to allocate large sums of public money will require much courage. No doubt this is why even the small steps at present envisaged are welcomed by quite a large number of people. They feel, no doubt, that any decision which is not negative at least provides some reason for keeping teams together. Yet the fact has to be faced that if Industry is left without decision too long, Britain's steps to the stars will never be taken. The skilled teams which could have built the vehicles to do the job will have been absorbed on other projects. And this country will have taken a decisive step backwards.

C

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Matters of Moment

Space Communications Initiated

AFTER a first failure on May 13, the U.S. successfully launched an Echo satellite into orbit at 10.40 BST on Aug. 12. Two-way radio communication between the east and west coasts of the U.S. has already been made using this 100-ft.-dia. inflated satellite as a passive reflector. Launched by a three-stage Thor-Delta vehicle, Echo 1 is in orbit with an apogee of 1,160 miles and a perigee of 1,018 miles. Its life is expected to be a year.

The object of the launching is to test the feasibility of a passive reflector communications system on a global scale. The inflatable satellite has a skin of thin Mylar plastic which is coated with a vapour-deposited layer of aluminium 0.0005 in. thick to give a radio wave reflectivity of at least 98% up to frequencies of 4,000 mc./sec. On reaching orbital altitude the folded satellite was released from its container. Residual pockets of air made it inflate partially, and additional gas for complete inflation was provided by 30 lb. of sublimating powders. The sphere and its casing weigh 131 lb.

Launching time of the satellite was planned so that it would remain continuously in sunlight for nearly a fortnight, so that it could be tracked visually. Viewed from the ground in Britain, the satellite appears about as bright as stars in the Plough constellation. The launch was planned for a 46° 58' orbit inclination so that the satellite would pass over all countries between the latitudes of 50° north and 50° south.

The balloon carries two tracking beacons transmitting on the same frequency; they are mounted 180° apart on the ball's equator. Any discontinuities in transmissions may indicate the state of inflation of the balloon.

The main facilities involved in the experiment are the Californian Goldstone tracking station of the NASA Jet Propulsion Laboratory and a Bell Telephone Laboratory Station at Holmdel, New Jersey. Goldstone is transmitting a 2,390 mc./sec. signal for interception at Holmdel and the Bell antenna is transmitting a 960 mc./sec. signal to be picked up at Goldstone. On any one pass the maximum time the satellite is visible from both the U.S. west and east coasts is about 16 minutes.

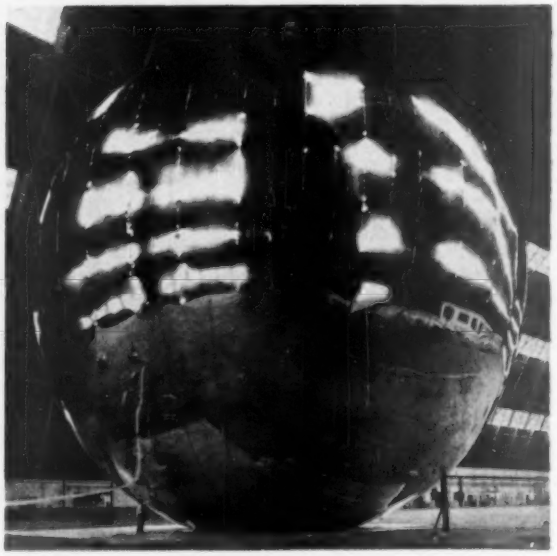
Twenty-five Miles High

THE X-15 flight on Aug. 12 had one unusual result apart from those which are not normally made public—its NASA pilot, Maj. R. White, had something to say about his impressions during the few seconds of the push-over at the end of the powered climb to 131,000 ft.

"This," he is reported to have said over the R/T, "is really fantastic up here." Afterwards, describing his visual impressions, he said: "It wasn't exactly night, but there was a very distinct contrast—a very deep blue. Your view encompasses three distinct bands—the Earth, the light blue of the sky and then the very deep blue of extreme altitude. It was very impressive."

No. 1 North American X-15 had been released from the B-52 at about 45,000 ft. and the programme for the four-minute powered flight involved a 51-deg. climb.

The present World altitude record (requiring a normal take-off) is 103,395 ft. This was achieved by Capt. J. B. Jordan in a Lockheed F-104C on Dec. 15, 1959. In September, 1956, the Bell X-2 research aircraft is believed to have reached 126,200 ft. after being released from its B-50 parent aircraft. The X-2 was lost later in the same month.

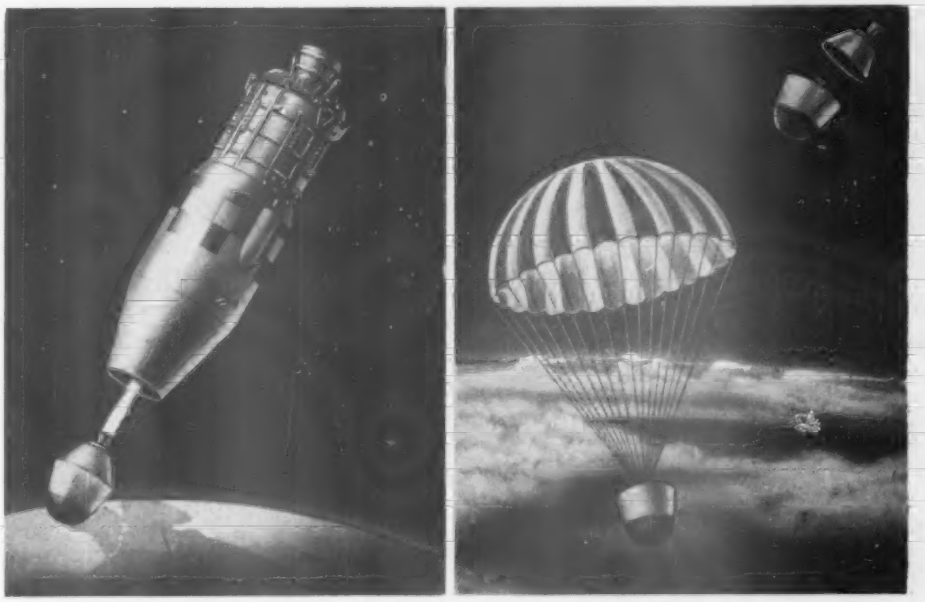


ECHO 1—In its inflated form the 100-ft. diameter Echo 1 balloon satellite launched on Aug. 12 is the largest man-made object yet put into orbit. It acts as a passive reflector for radio transmissions.

Recovery from Orbit

RECOVERY of the 300-lb. re-entry capsule from the satellite Discovery XIII on Aug. 11 marks a signal step in the development of astronautics. Before a man could be sent into orbit in the Mercury capsule—the Americans hope next year—it was vital that the re-entry characteristics of an instrumented body were adequately proved. The final step has now been achieved and it remains to repeat the experiment both with

STOL TAKE-OFF—Assisted by two de Havilland Spectre 4 rocket engines, a Handley Page Victor takes off in 550 yds. These assisted take-off rocket engines each give 8,000 lb. thrust; they are mounted in jettisonable pods.



How the Discoverer capsule was recovered. Left, Agena satellite is stabilized in a backward attitude at 60° for capsule ejection by means of a retro-rocket. Capsule follows a curved path in the same direction as the satellite to re-enter the atmosphere; tail-fairing jettisons (inset, right), and parachute deploys for recovery.

further Discoverer capsules and actual one-ton Mercury capsules containing instruments and test-animals.

The importance of gaining first-hand experience of the physical reactions of long periods of weightlessness on living organisms cannot be too greatly stressed. It should now be possible to orbit animals in Discoverer capsules, expose them to the weightless condition for several hours, and recover them for physical examination. An early attempt was actually made in the Discoverer programme to orbit four black-haired mice, but the second stage of the launching rocket failed on that occasion.

A further result of the American experiment is that it has shown the possibility of recovering scientific equipment of all kinds (including photographic emulsions) from orbit. It should also be possible in future satellites to send film cameras into low orbits to survey the Earth's surface and obtain the actual recovery of film, rather than convert the photographic image into TV pictures with inevitable loss in resolution. This, of course, has the greatest importance in the development of reconnaissance satellites with which the Americans are hoping to replace reconnaissance aircraft in the years ahead.

The capsule from Discoverer XIII, which ejected on the satellite's 16th orbit, was recovered from the Pacific Ocean some 330 miles from Honolulu. Although its parachute descent was spotted from C-119 patrolling aircraft, they could not manage to snare it in their trailing " nets " and it was picked up from the sea by a helicopter.

Particulars of the Discoverer programme were given in THE AEROPLANE AND ASTRONAUTICS, Jan. 1, 1960, pp. 21-22. A description of the capsule ejection technique appears on page 224 of this issue.

M.o.A. Electronics Specialist

AIR VICE-MARSHAL T. U. C. SHIRLEY, C.B.E., M.I.E.E., F.R.Ae.S., is to be Deputy Controller of Electronics in the Ministry of Aviation in succession to Air Vice-Marshal G. P. Chamberlain, C.B., O.B.E., who is retiring from the Royal Air Force at the end of August.

Born at Aldershot in 1908, the new D.C.E. joined the R.A.F. as an aircraft apprentice in 1925. He was commissioned in the GD branch in 1930. He took the Specialist Signals Course in 1934 and served in the Far East and the Middle East until 1941. In that year he returned to England and took command of No. 73 and 75 Signals Wings.

At the end of the War he took the 16 (War) Staff Course at Bracknell, and in 1946 was appointed Deputy Director of Signals. In 1948 he went to the Joint Services Staff College, Latimer, and after graduation was appointed Deputy Director of Technical Plans at the Air Ministry. In 1950 he was made an Aide-de-Camp to His Late Majesty King George VI and afterwards to H.M. the Queen. In 1951 he was made Director of Radio Engineering in the Air Ministry, and from 1953 until 1955 he was Chief Signals Officer to Fighter Command. After a year at the Imperial Defence College he became Commandant at the R.A.F. Technical College, Henlow (1957-59). Since early 1959 he has been Senior Technical Officer, Fighter Command.

A.W.A. Chairman to Retire

LAST week on his seventieth birthday, Mr. H. M. Woodhams, C.B.E., F.R.Ae.S., M.I.Prod.E., announced his intention to resign as chairman and managing director of Sir W. G. Armstrong Whitworth Aircraft, Ltd., and also to give up his Hawker Siddeley Aviation directorship as from Aug. 31. He has been prevailed on to remain a member of the board of A.W.A., Ltd., so that advice based on his vast fund of experience will continue to be available to the company.

In his early days he participated in some historic activities of another company soon to be forty years old which has recently associated itself with Hawker Siddeley Aviation; but before recounting this part of the story it is necessary to recall that back in 1908 when A. V. Roe was working at his earliest experiments, the young Herbert Woodhams was working on the Hammond triplane at Brooklands.

During the First World War he joined the Middlesex Regt. but was pulled out to work at Peter Hookers which concern was building the Mono Gnôme at Walthamstow. As a specialist on these engines he was seconded to the Aircraft Manufacturing Company where Geoffrey de Havilland was then chief designer.

After the Armistice Mr. Woodhams became the first man in this country to hold a ground engineer's licence for aero engines under the Air Navigation Directions of 1919. This distinction was recalled in 1956 when Mr. Woodhams became the first recipient of the " Silver Turnbuckle " of the Society of Licensed Aircraft Engineers. After being chief engineer to Aircraft Transport and Travel, Ltd., and the Air Post of Banks, Ltd., he rejoined the de Havilland team on the formation of the de Havilland Aircraft Company in 1920.

Three years later he set off as engineer with Alan Cobham on a 10,000-mile charter tour round the Mediterranean in a D.H.9.

So when he came to join the three-year-old Sir W. G. Armstrong Whitworth Aircraft Company in 1923 as chief

A.V.M., T. U. C. Shirley.

Mr. H. M. Woodhams

Matters of Moment . . . .

inspector he had a wealth of practical experience behind him. Within 16 years he had become works manager. By 1941 he had been elected director.

It was during these wartime years that the practical experience of Woodhams and the team he had built up produced such tremendous dividends for the country. The production record of A.W.A. over that period has remained unsurpassed. The output of aircraft weight per man-hour was outstanding and was regularly maintained. For these achievements no praise can be too great. Mr. Woodhams was awarded the C.B.E. in 1944.

He became managing director of A.W.A., Ltd., in 1950 and by the time he was made chairman as well as managing director in 1959 he had seen through to successful flight trials the latest product of the company, the A.W.A. Argosy which promises to become even better known internationally than the first A.W.A. airliner to bear the name which was produced for Imperial Airways when Herbert Woodhams was chief inspector.

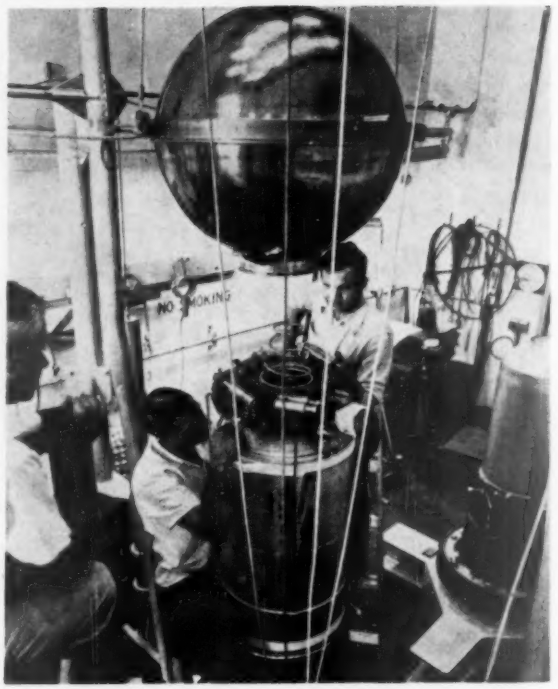
May the company which "Woodie" has done so much to launch successfully continue for many years.—T.J.

How Late Will Skybolt Be?

SOME grounds for doubt about the achievement of the development schedule for Skybolt appear to exist. According to *Aviation Week*, the USAF is worried about the ability of Douglas to meet the projected development schedule for the Skybolt air-launched ballistic missile. Shortage of design manpower is given as the main reason and it is suggested that only about 60% of the designers required are at present working on the project.

As a result of this, it is reported that firm engineering directions to sub-contractors have been delayed and "follow-up engineering tasks" are still unassigned.

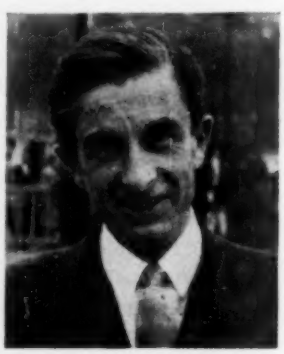
The preliminary development engineering inspection of the missile and its pylon was held at the Douglas Culver City plant early this month. The first firing of a missile without its guidance system will probably be made next summer. This is somewhat later than the "early next spring" date quoted by Mr. Watkinson in Parliament on Jly. 20. Firing trials with the complete missile system will probably not be made before early 1962, according to the U.S. report.



ECHO SATELLITE.—The spherical container for the 100-ft.-diameter Echo satellite is separated from the third stage of the Delta launch vehicle by a large spring. In this view Douglas engineers are spin-balancing the third stage. Orbital spinning and tumbling of this stage are counteracted by the small rocket motors at the base of the spring.

British Aviation Loses a Friend

WE regret to announce the death at his home on Aug. 9 in France of M. Morel, "Gerry" Morel, as he was known so well in aviation circles in England and in his own country, where he had started the *Société Commerciale et Industrielle Franco-Britannique* working in association with well-known aricraft firms in this country. He was for many years the correspondent in France of the S.B.A.C.



Gerry Morel.

Born on Aug. 21, 1907, and educated in France, he became an actuary and insurance broker. At the outbreak of war he was appointed liaison officer with the 51st Highland Division. At the end of the War he was a Major in the French Army, an honorary Major in the British Army and his decorations included: Military M.B.E., Chevalier of the Legion d'Honneur, Medal of the Resistance, Croix de Guerre and American Silver Star.

Of his achievements which earned them Maurice Buckmaster* writes:—

> Gerry Morel was among the very first of that band of courageous men and women to volunteer for service in Occupied France. I remember him presenting himself in the spring of 1941 at our reception centre not far from Baker Street. He had but one idea—to establish contact with his friends in France, who, like him, had vowed to achieve the liberation of their country, and to bring them aid from Britain. This was his unswerving aim: he lived only for its accomplishment.

His first mission was one of great importance—to form an estimate, for the consideration of the War Cabinet, of what proportion of Frenchmen professing sympathy for the Allied cause would actively support it, at the risk, maybe, of their lives. He was taken by Lysander aircraft to a point near Chateauroux, where he was met by French Resistance friends, who brought a spare bicycle for Gerry to ride. His adventures were epical and the results of his research of the greatest value.

After only a few months' work, he was the victim of a trap laid by the French Milice for another member of the organization, and was imprisoned at Mauzac. He became seriously ill in prison, and whilst recovering from an emergency operation, he gave his captors the slip and proceeded to make his way on foot over the Pyrenees to Spain and thence to London. In so doing, he must have done incalculable injury to himself, injury which persisted throughout his life.

Despite all his protests he was forbidden to participate in further operations in France, but, after being transferred, at the winding-up of the French Section, to the Free French Staff in London (*Etat-Major des Forces Francaises de l'Interieur*) under General Koenig, he persuaded the French authorities to allow him to go on an operation in the Jura in July, 1944, in which he distinguished himself greatly.

If, between 1942 and D-day, Gerry fumed at his enforced inactivity in London, I congratulated myself upon it, for Gerry's experience, his determination, his almost fanatical zeal, made him the ideal briefing officer for other less experienced agents. He spent himself unsparingly in imparting knowledge to these men and women: he was adored by them all, not only because of his own brilliant example, but by his shining, transparent beauty of character.

Gerry was a man that everybody loved and admired. I consider myself much honoured to be permitted to pay this tribute to a very dear friend.

* M. J. Buckmaster was Head of the French Section of Special Operations Executive from 1941 until the end of the War.

Air Transport

That Very Near Miss

The detailed story behind last week's incident involving a Viscount and a 707. The facts were obtained with the co-operation of the Italian authorities by Wg. Cdr. T. D. CALNAN for this exclusive report.

THE sensational aspects of the near-miss at Rome on Aug. 11 are already well known. At about 11.40 hrs. (all times Z) a Pan American Boeing 707 and a B.E.A. Viscount avoided a mid-air collision only because both pilots took violent evasive action at the last moment. This occurred at about 8,000 ft. in the vicinity of the Rome NDB, Lima Juliet, which is located at Urbe on the outskirts of Rome. The 707 carried 81 passengers and a crew of 10; the Viscount carried 49 passengers and a crew of five. Thus an accident of frightening proportions was avoided, if only by the closest of margins. As it was, some 24 passengers in the Viscount and two of the crew were injured.

This was because the Viscount's avoiding action was to dive, so inflicting considerable negative *g* on the passengers. It appears that few, if any, safety belts were fastened at the time and the negative *g* thus threw passengers violently against the roof or luggage racks. The 707's avoiding action, on the other hand, was to climb, and passengers were subjected only to the momentary discomfort of positive *g* and there were no injuries from violent impact.

The Italian authorities, who are taking a most grave and concerned view of the incident, gave me every possible facility to discover the basic facts in order to prepare this report for THE AEROPLANE AND ASTRONAUTICS. Most of the story is told by the tape recordings of the R/T between Rome A.C.C. and the two aircraft concerned.

The 707, Panam Flight 114, Callsign Clipper 114, was inbound to Ciampino from Paris. The Viscount, B.E.A. Flight 141, Callsign Oscar Papa, was inbound to Ciampino from Malta. Both aircraft were using the same frequency while they remained under control of Rome A.C.C. and it can safely be assumed that each heard Rome A.C.C.'s transmissions to the other.

The transcript of the tape recordings starts at 11.27 hrs., at which time Viscount Oscar Papa reported its position at 18,000 ft. abeam NDB (non-directional beacon) Latina. At 11.28 hrs. Clipper 114 reported itself over NDB Giglio at 18,000 ft. Oscar Papa was flying an IFR flight plan and its route was Amber 1 from NDB Ponza to abeam NDB Latina, and thence NDB Pratica to NDB Lima Juliet, the Rome beacon. Clipper 114's route, also an IFR flight plan, was NDB Giglio, NDB Civita Vecchia, and thence NDB Lima Juliet. If both aircraft had maintained their IFR flight plans they would have remained under the close control of Rome A.C.C. until they had left Lima Juliet beacon to go into Ciampino.

Both aircraft proceeded normally, acting on instructions from Rome A.C.C. from 11.27 until 11.34 hrs. This is a critical time in the history of events. Immediately before, at 11.33 hrs., the situation was that Oscar Papa had been cleared to the Lima Juliet beacon at 14,000 ft., had passed NDB Pratica but was not yet abeam of NDB Ostia. Oscar Papa had announced its estimated time at Lima Juliet as 11.37 hrs. At 11.33 hrs. Clipper 114 reported over NDB Civita Vecchia at 18,000 ft. and received instructions to descend to and maintain 15,000 ft., to hold N.W. of Lima Juliet beacon and was given an estimated arrival time of 11.43 hrs.

TIME	FROM	TO	MESSAGE
11.32	Rome A.C.C.	Oscar Papa	Proceed to Lima Juliet. Check abeam Ostia.
11.32½	Rome A.C.C.	Oscar Papa	When do you estimate Lima Juliet?
11.32½	Oscar Papa	Rome A.C.C.	Estimate 37
11.33	Clipper 114	Rome A.C.C.	Over Civita Vecchia. Flight level 18,000 ft.
11.33	Rome A.C.C.	Clipper 114	Descend and maintain F.L. 15,000. Hold N.W. Lima Juliet. E.A.T. 43
11.34	Clipper 114	Rome A.C.C.	Can see airfield. Cancel IFR flight plan.
	Rome A.C.C.	Clipper 114	Roger. Cancellation 34. Proceed VFR. Change to 118.3 (Ciampino Tower). QNH etc.
	Clipper 114	Rome A.C.C.	Changing over.
	Rome A.C.C.	Oscar Papa	Descend to flight level 8,000 ft.
	Oscar Papa	Rome A.C.C.	Leaving flight level 14,000 ft.
11.35	Rome A.C.C.	Oscar Papa	Change to 124.1 (Ciampino Approach).
	Oscar Papa	Rome A.C.C.	Abeam Ostia now down to flight level 8,000 ft.

The tape recorder transcript tells the story. The R/T conversation is summarized in the table (left, below).

The key to the whole sequence of events is Clipper 114's change of flight plan. If he had maintained his original IFR flight plan he would have been cleared into Lima Juliet six minutes after Oscar Papa and no incident would have occurred. By changing to a VFR flight plan, he ceased to come under the close control of A.C.C. Rome and assumed all responsibility for the position and safety of his aircraft and for the avoidance of other aircraft.

It should be clearly understood, however, that this change of flight plan was an entirely normal and accepted procedure. The decision is the pilot's and it must always be accepted by the A.C.C., provided that weather and traffic conditions are suitable. In this case the weather was good with excellent visibility and there was no traffic problem. A.C.C. Rome's acceptance of the change of flight plan was, therefore, normal and justified.

The Significant Point

The motive for such a change of flight plan is also of considerable significance. I have not talked to the pilot, so it must be made clear that I am now dealing with conjecture. There is the obvious possibility, however, that the motive, in this case, was to save time. With permission to proceed direct, VFR, from Civita Vecchia to Ciampino, Clipper 114 would avoid the IFR procedure at Lima Juliet beacon and fly direct to the area west of Ciampino, make a U-turn, still to the west of Ciampino, which would bring him on to the downward leg, and land off a right-hand turn. He was, in fact, instructed by Ciampino Tower to carry out exactly this procedure. It is possible, therefore, that Clipper 114's motive was to land at Ciampino before Oscar Papa, by calling downwind at Ciampino before Oscar Papa had been cleared from Lima Juliet beacon. This would represent a saving of valuable minutes and, it must be emphasized, was an entirely legitimate calculation and manœuvre by the captain.

There is no doubt at all that Clipper 114 should not have been anywhere in the vicinity of Lima Juliet beacon on his VFR approach to Ciampino. There is a NOTAM in force which states specifically that pilots shall avoid the Lima Juliet area when carrying out a VFR approach from Civita Vecchia.

The near-miss occurred while Viscount Oscar Papa was just starting a procedure turn over Lima Juliet at 11.40 hrs. I have not seen evidence which establishes that Oscar Papa's position was, in fact, the Lima Juliet beacon. It may be significant that Clipper 114, according to the tape-recorded evidence, may have changed already to the tower frequency when Oscar Papa was given his flight level of 8,000 ft. for Lima Juliet. Up to that point, his flight level had been 14,000 ft. If the pilot of Clipper 114 was making a direct approach to Ciampino through the Lima Juliet area, it is possible that he thought that Oscar Papa was at a flight level higher than 8,000 ft.

At this stage it is important to correct an opinion already openly expressed in the U.K. Press that this incident was one of a series due to the inefficiency of the Italian Air Traffic Control system. In the case of the incident in question, no blame whatsoever can be attributed to Rome A.C.C. or airfield control. It is difficult to see how either the procedures adopted, or the instructions given to the two aircraft, can in any way be faulted. It would be going too far to suggest that, in the clear weather conditions prevailing, with only two aircraft inbound at the

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same time, there was anything intrinsically dangerous, or even unusual, in controlling the one with standard IFR procedure while allowing the other to follow a straightforward VFR procedure.

There is only one remedy. Air traffic control systems must be given the equipment whereby they can be aware of, and control, any indiscipline—which means more radar equipment. Rome A.C.C. has a surveillance radar but it is used solely to control departures and to feed them into the airways. This is a limitation which will, in due course, be remedied as more trained personnel become available. Italy's problem in this respect is a particularly difficult one in that not only do the selected personnel have to be trained to become efficient controllers, but they also have to be efficient controllers in the English language. Italy, however, is solving this problem rapidly and its controllers are being trained under the supervision of a Ministry of Aviation expert.

Overall, Italy's system of air traffic control is efficient and based entirely on ICAO regulations. There are gaps in its equipment, but these are in the process of being filled and, indeed, very large sums of money are being spent on new equipment. For instance, by September of this year Italy will have in operation a complete VOR coverage of 17 stations built at a cost of some £450,000. The men with the executive responsibility for Italy's air traffic control system, the directors of the A.C.C.s, for instance, are all air force officers, a large part of whose career has been in civil aviation. Almost without exception, they are able and dedicated men with long experience of air traffic control.

New Names for Old

TWO of the transport projects on which the industry is now at work have recently been named. They are the D.H. 121, which is to be the Trident, and the ATL. 98, now known as the Carvair.

Both names were chosen from entries in competitions run respectively by B.E.A. and by Channel Air Bridge. Over 1,000 suggestions were made in the D.H. 121 competition, the name Trident being selected by a panel of judges headed by Lord Douglas of Kirtleside. A trident is a three-pronged spear traditionally associated with Britannia; it has, says de Havillands, "a natural allusion to the new formula of this advanced aircraft with its triplex arrangement of engines, controls and systems."

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The BAC-107

AMONG the more fully developed projects of the British Aircraft Corporation is the short-haul BAC-107 turbofan transport. This rear-engined, swept-wing design was begun by Hunting Aircraft some four years ago as the H-107, and was at first powered by two Bristol Siddeley Orpheus turbojets. Convinced of the need for such an aeroplane as a Viscount and Convair replacement on the more important feeder routes throughout the World, the Hunting staff kept the design under constant review, and last year adopted Bristol Siddeley turbofan engines in place of the Orpheus.

Since Hunting became a member company of the British Aircraft Corporation, the design has been further developed, taking advantage of Vickers-Armstrongs (Aircraft) experience and knowledge of rear-engined layouts. A major design change has been made to raise the tailplane to the top of the fin (as on the VC10) and weights have been increased. The design range is 950 naut. miles with maximum payload, including 50 passengers four abreast or 59 five-abreast.

The favoured engine at present is the Bristol Siddeley BS.75, one of that company's range of ducted fans with a take-off rating of 7,350 lb.

Newest data for the BAC-107, models of which will be displayed on the B.A.C. stand at Farnborough, follow:—

Dimensions: Span, 81 ft. 8 in.; length, 84 ft. 11 in.; height, 23 ft.; gross wing area, 825 sq. ft.

Weights: Basic operational, 29,000 lb.; total fuel (2,230 Imp. gal.), 17,840 lb.; max. payload, 12,000 lb.; max. take-off, 48,500 lb.; max. zero fuel, 41,000 lb.; max. landing, 46,000 lb.

Performance: Typical cruising speed, 400 knots at 32,000 ft. at 44,000 lb.; field length required (I.S.A., s.l., max. wt.), 4,700 ft.; landing distance from 50 ft. (unfactored, max. wt.), 2,800 ft.; no-reserves range in still air, with max. fuel, 2,500 naut. miles; with max. payload, 950 naut. miles.

James Jeffs for B.O.A.C.

ON his retirement as Commandant of London Airport at the end of next month Mr. G. J. H. Jeffs, C.V.O., O.B.E., is to be retained by B.O.A.C. on a part-time basis to advise and assist the Corporation's management at L.A.P.

Mr. Jeffs, who was 60 last January, holds Air Traffic Control Licence No. 1 and was control officer at Croydon Airport from 1922 to 1934. He was appointed Commandant of Prestwick in 1950 and of L.A.P. in 1956.

John Brancker Leaves IATA

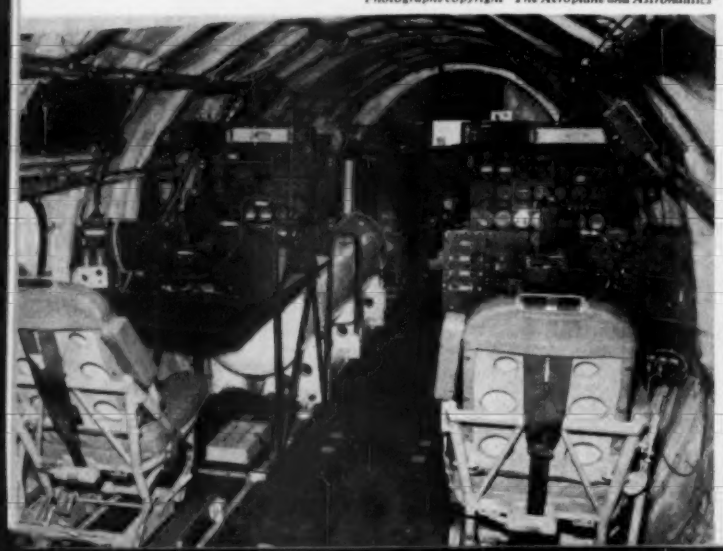
RUMOURS were confirmed last week when we learned from Montreal that Mr. J. W. S. Brancker, traffic director of the International Air Transport Association since August, 1953, left at the end of July.

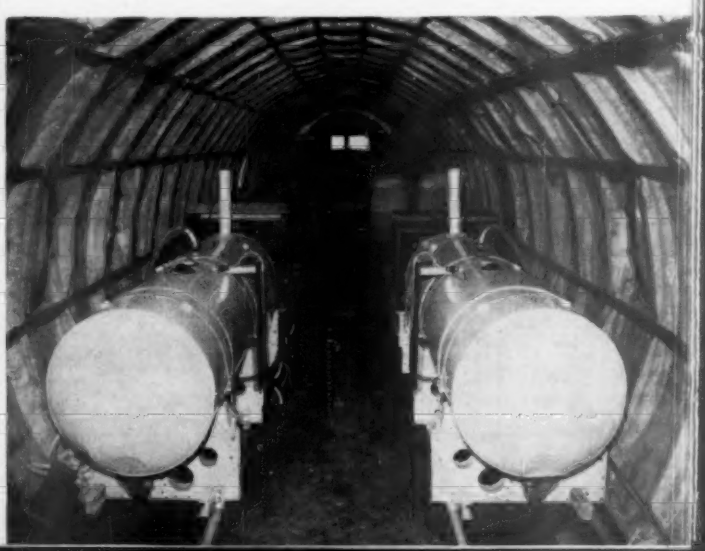
No official reasons can at present be given, though it is likely that the matter will be discussed by the Association's executive committee at or before the annual general meeting in Copenhagen next month. The functions of traffic director are being exercised, *pro tem*, by Sir William Hildred, IATA's director general.

Before joining the Association, John Brancker was B.O.A.C.'s general manager, international affairs, and he has been concerned with air transport since joining Imperial Airways in 1929.

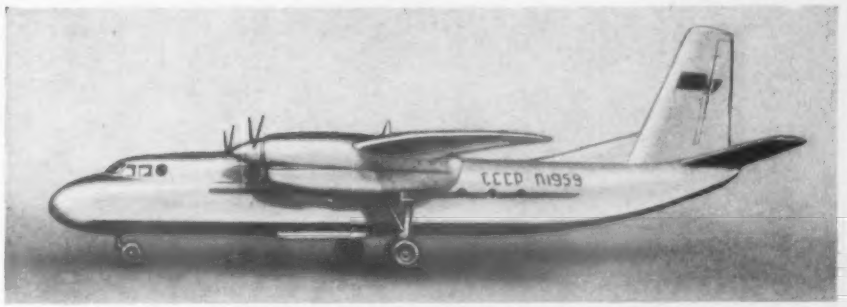
These two pictures show the interior of the prototype Avro 748 which, as we reported in our July 29 issue, completed 60 hours flying in its first month of trials. Water tanks have been installed fore and aft to allow rapid changes of C.G. in the air, and there are two flight observers' stations.

Photographs copyright "The Aeroplane and Astronautics"





The New Soviet Airliners



The Antonov An-24 feeder liner, now undergoing flight tests.

A FEW details have recently appeared in the Soviet aviation Press of the two new airliners now in the flight-test stage—the Tu-124 and the An-24. The former was illustrated in our issue for Jly. 15 and the latter in that for Jly. 29. The latest illustrations of the An-24 show a machine bearing the registration CCCP-L1960, whereas the earlier photographs illustrated CCCP-L1959—indicating the existence of at least two prototypes.

The Tu-124, with its two high-economy Soloviev turbofan engines, is designed for operation at heights up to 33,000 ft., at a maximum speed of 540 m.p.h. and has a range of 930 miles (1,500 kms.). The short take-off run—2,625 ft.—allows the aircraft to operate from runways of less than 5,000 ft. with conventional safety margins.

Normal crew of the Tu-124 comprises two pilots, a flight engineer and steward, but there is provision in the navigator's compartment, in the nose, for an instructor, and a wireless operator can be accommodated on a removable seat on the flight deck. The forward entrance is on the port side just aft of the flight deck, with the forward baggage compartment opposite, closed with a shuttered door and curtain.

A buffet-kitchen is situated aft of the entrance vestibule and is fitted with catering equipment, cupboards and thermos containers for hot and cold dishes, coffee and tea.

The passenger cabin provides three basic layouts, with 44 first-class, 55 to 60 tourist- or 68 economy-class seats. The seats are mounted on rails, which can also take Tu-104A-type seats and have 40 degrees of tilt.

In the first-class layout, the cabin is divided into three compartments, containing 12, 8 and 24 seats respectively; the centre compartment is stepped up over the wing main spar. The seats are arranged in pairs with tables between the first two rows in each compartment, so that 12 of the seats are rearward facing.

Behind the passenger cabin there is a rear-entrance vestibule, with port side door for passenger entry, and a wardrobe opposite. Aft again are the toilet and a door to the rear baggage compartment. Baggage, mail and freight are loaded through an external hatch on the starboard side.

Decoration of the cabin is in light-toned fireproof plastic and the windows and cabin roof lighting are surrounded with rare wood panelling—lemon and nut woods.

Powered by two 2,000-h.p. Ivchenko turboprops, the An-24 was designed and constructed in very short time. Designed for operation from natural-surface airfields, it has a take-off run of 1,320-1,470 ft. and cruises at 310 m.p.h. at 20-25,000 ft. The passenger capacity varies from 32 to 42 for stage lengths of 500 to 750 miles.

The crew comprises two pilots, navigator and steward. The An-24 is fitted with the latest flying instruments, radio and radio navigation aids. Thermal de-icing is used on the mainplane—exits for hot air are visible at the wing tips in the pictures which have been published.

The aircraft's high wing has a number of interesting constructional features. The centre section is made up of eight large basic panels. Electric contact spot welding has been used in attaching the wing skin to load-bearing elements and the welding of metal seams has been adopted. This has led to a big reduction in the number of rivets used, and the pressurization and drag characteristics have been improved.

Many parts of the aircraft are made of new-type materials which are much lighter than metal, are stronger and do not corrode. Examples are the trim tabs and antenna coverings in glass fibre, and bolts and screws made of polyamide resins of the nylon type.

The passenger cabin is decorated in light-coloured plastic material and the seats are comfortable and adjustable. There is good thermal and sound insulation in the pressurized cabin, which is lit by daylight-type lighting, used for the first time in a Soviet aircraft.

Sabena and the Congo

NO estimate can yet be made of the cost to Sabena of the recent emergency airlift from the Congo or of the more lasting consequences of Congo independence. More details are now available of the extent of the airlift, which for 14 days occupied the whole of Sabena's long and medium-haul fleet, leaving only five Convair Metropolitans to operate in Europe.

The airlift began as an emergency measure on Jly. 9, after the Congo Force Publique had mutinied, and was maintained at maximum pressure for 14 days. From Jly. 22, the pace of operations was allowed to run down as aircraft were transferred back to Sabena's other routes, and by Jly. 28 the airlift was virtually at an end, although refugees were still flying back on scheduled services from the Congo.

In the peak period, Sabena committed its five Boeing 707s, eight DC-7Cs, 12 DC-6 and 6Bs and one DC-4 to the ferry operations between the Congo and Europe. In addition, the local fleet of four DC-4s, four Convair 440s and 13 DC-3s were used to bring refugees into the main departure airports of Leopoldville, Elisabethville and Kamina. To help cope with the enormous demand in the first few days, Sabena also chartered aircraft from at least 11 other airlines, and a contribution was made by the R.A.F. (see our issue for Jly. 29) and by the U.S.A.F.

All the Sabena aircraft were operated in all-economy configuration, but on most flights many children were carried, to bring the number of passengers well above the number of seats. For instance, the Boeing 707s had 188 seats but usually had at least 250 names on the passenger list; the record was 293 passengers and a crew of ten. A DC-3 carried 77 occupants on one flight. In all, Sabena had carried 25,711 passengers out of the Congo by Jly. 28, including 8,327 children and 1,888 infants. They were carried on 209 flights to Europe including 62 by Boeing 707s and the airlift flight hours totalled 6,217. Another 8,773 refugees were carried by other airlines in the same period.

Normal maintenance procedures and aircrew duty schedules were amended to allow each aircraft with one crew to make the fastest possible round trip between Brussels and the Congo. The Boeing 707s were averaging about 18 hr. for the return trip, including two hours on the ground at Leopoldville. DC-7s took about 14 hr. each way and DC-6s about 17 hr.

Over-flying Africa

SOUTH AFRICAN AIRWAYS' provisional time-table for Boeing 707-344 services between the Union and the U.K. shows the effects both of landing restrictions in certain African areas and of the bigger capacity made available. Four return services a week will be operated by comparison with the present five with DC-7Bs, and the one west-coast service will be operated with only a single stop—at Brazzaville instead of Leopoldville—between Johannesburg and Rome.

The Great Circle distances on this run are 1,510 naut. miles from Johannesburg to Brazzaville and 2,767 naut. miles from Brazzaville to Rome. The aerodrome reference temperature at Brazzaville (Maya Maya) is just over 28° C. (82.5° F.) and the runway length is 7,545 ft. by comparison with Leopoldville's 15,420 ft.—so there may be payload restrictions on the northbound service.

The routeing for the other three services will be via Salisbury and Nairobi to Rome (2,905 naut. miles), with one operating via Athens to Rome.

S.A.A.'s 707s are laid out for 32 first-class and 93 economy class passengers—so there will be capacity for 500 passengers a week each way in comparison with 330-400 a week with the DC-7Bs.

Air Transport . . . .

same time, there was anything intrinsically dangerous, or even unusual, in controlling the one with standard IFR procedure while allowing the other to follow a straightforward VFR procedure.

There is only one remedy. Air traffic control systems must be given the equipment whereby they can be aware of, and control, any indiscipline—which means more radar equipment. Rome A.C.C. has a surveillance radar but it is used solely to control departures and to feed them into the airways. This is a limitation which will, in due course, be remedied as more trained personnel become available. Italy's problem in this respect is a particularly difficult one in that not only do the selected personnel have to be trained to become efficient controllers, but they also have to be efficient controllers in the English language. Italy, however, is solving this problem rapidly and its controllers are being trained under the supervision of a Ministry of Aviation expert.

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Dimensions: Span, 81 ft. 8 in.; length, 84 ft. 11 in.; height, 23 ft.; gross wing area, 825 sq. ft.

Weights: Basic operational, 29,000 lb.; total fuel (2,230 Imp. gal.), 17,840 lb.; max. payload, 12,000 lb.; max. take-off, 48,500 lb.; max. zero fuel, 41,000 lb.; max. landing, 46,000 lb.

Performance: Typical cruising speed, 400 knots at 32,000 ft. at 44,000 lb.; field length required (I.S.A., s.l., max. wt.), 4,700 ft.; landing distance from 50 ft. (unfactored, max. wt.), 2,800 ft.; no-reserves range in still air, with max. fuel, 2,500 naut. miles; with max. payload, 950 naut. miles.

James Jeffs for B.O.A.C.

ON his retirement as Commandant of London Airport at the end of next month Mr. G. J. H. Jeffs, C.V.O., O.B.E., is to be retained by B.O.A.C. on a part-time basis to advise and assist the Corporation's management at L.A.P.

Mr. Jeffs, who was 60 last January, holds Air Traffic Control Licence No. 1 and was control officer at Croydon Airport from 1922 to 1934. He was appointed Commandant of Prestwick in 1950 and of L.A.P. in 1956.

John Brancker Leaves IATA

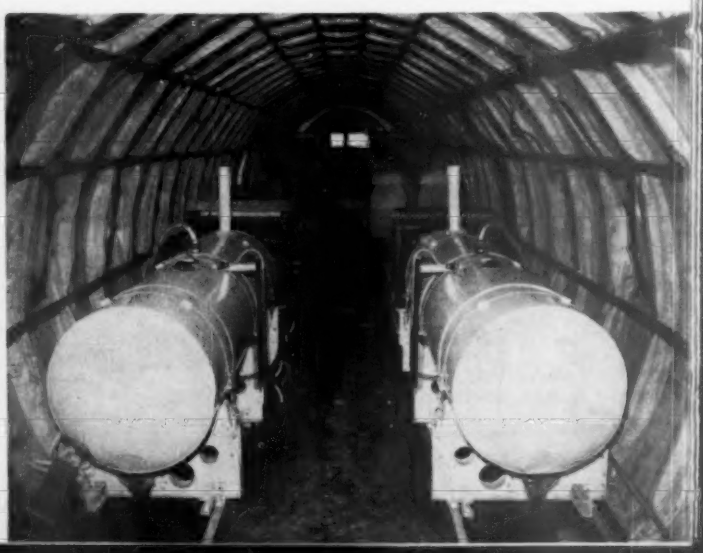
RUMOURS were confirmed last week when we learned from Montreal that Mr. J. W. S. Brancker, traffic director of the International Air Transport Association since August, 1953, left at the end of July.

No official reasons can at present be given, though it is likely that the matter will be discussed by the Association's executive committee at or before the annual general meeting in Copenhagen next month. The functions of traffic director are being exercised, *pro tem*, by Sir William Hildred, IATA's director general.

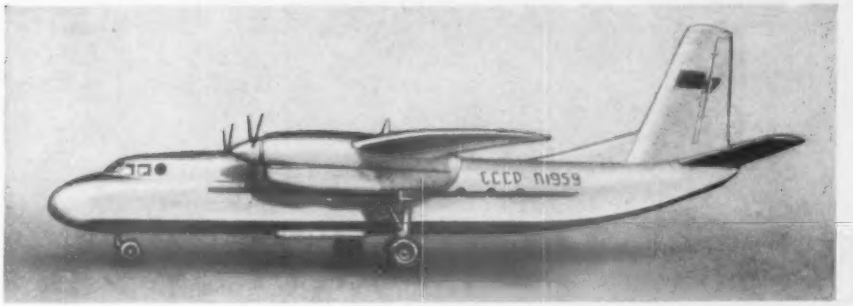
Before joining the Association, John Brancker was B.O.A.C.'s general manager, international affairs, and he has been concerned with air transport since joining Imperial Airways in 1929.

These two pictures show the interior of the prototype Avro 748 which, as we reported in our July 29 issue, completed 60 hours flying in its first month of trials. Water tanks have been installed fore and aft to allow rapid changes of C.G. in the air, and there are two flight observers' stations.

Photographs copyright "The Aeroplane and Astronautics"



The New Soviet Airliners



The Antonov An-24 feeder liner, now undergoing flight tests.

A FEW details have recently appeared in the Soviet aviation Press of the two new airliners now in the flight-test stage—the Tu-124 and the An-24. The former was illustrated in our issue for Jly. 15 and the latter in that for Jly. 29. The latest illustrations of the An-24 show a machine bearing the registration CCCP-L1960, whereas the earlier photographs illustrated CCCP-L1959—indicating the existence of at least two prototypes.

The Tu-124, with its two high-economy Soloviev turbofan engines, is designed for operation at heights up to 33,000 ft., at a maximum speed of 540 m.p.h. and has a range of 930 miles (1,500 kms.). The short take-off run—2,625 ft.—allows the aircraft to operate from runways of less than 5,000 ft. with conventional safety margins.

Normal crew of the Tu-124 comprises two pilots, a flight engineer and steward, but there is provision in the navigator's compartment, in the nose, for an instructor, and a wireless operator can be accommodated on a removable seat on the flight deck. The forward entrance is on the port side just aft of the flight deck, with the forward baggage compartment opposite, closed with a shuttered door and curtain.

A buffet-kitchen is situated aft of the entrance vestibule and is fitted with catering equipment, cupboards and thermos containers for hot and cold dishes, coffee and tea.

The passenger cabin provides three basic layouts, with 44 first-class, 55 to 60 tourist- or 68 economy-class seats. The seats are mounted on rails, which can also take Tu-104A-type seats and have 40 degrees of tilt.

In the first-class layout, the cabin is divided into three compartments, containing 12, 8 and 24 seats respectively; the centre compartment is stepped up over the wing main spar. The seats are arranged in pairs with tables between the first two rows in each compartment, so that 12 of the seats are rearward facing.

Behind the passenger cabin there is a rear-entrance vestibule, with port side door for passenger entry, and a wardrobe opposite. Aft again are the toilet and a door to the rear baggage compartment. Baggage, mail and freight are loaded through an external hatch on the starboard side.

Decoration of the cabin is in light-toned fireproof plastic and the windows and cabin roof lighting are surrounded with rare wood panelling—lemon and nut woods.

Powered by two 2,000-h.p. Ivchenko turboprops, the An-24 was designed and constructed in very short time. Designed for operation from natural-surface airfields, it has a take-off run of 1,320-1,470 ft. and cruises at 310 m.p.h. at 20-25,000 ft. The passenger capacity varies from 32 to 42 for stage lengths of 500 to 750 miles.

The crew comprises two pilots, navigator and steward. The An-24 is fitted with the latest flying instruments, radio and radio navigation aids. Thermal de-icing is used on the mainplane—exits for hot air are visible at the wing tips in the pictures which have been published.

The aircraft's high wing has a number of interesting constructional features. The centre section is made up of eight large basic panels. Electric contact spot welding has been used in attaching the wing skin to load-bearing elements and the welding of metal seams has been adopted. This has led to a big reduction in the number of rivets used, and the pressurization and drag characteristics have been improved.

Many parts of the aircraft are made of new-type materials which are much lighter than metal, are stronger and do not corrode. Examples are the trim tabs and antenna coverings in glass fibre, and bolts and screws made of polyamide resins of the nylon type.

The passenger cabin is decorated in light-coloured plastic material and the seats are comfortable and adjustable. There is good thermal and sound insulation in the pressurized cabin, which is lit by daylight-type lighting, used for the first time in a Soviet aircraft.

Sabena and the Congo

NO estimate can yet be made of the cost to Sabena of the recent emergency airlift from the Congo or of the more lasting consequences of Congo independence. More details are now available of the extent of the airlift, which for 14 days occupied the whole of Sabena's long and medium-haul fleet, leaving only five Convair Metropolitans to operate in Europe.

The airlift began as an emergency measure on Jly. 9, after the Congo Force Publique had mutinied, and was maintained at maximum pressure for 14 days. From Jly. 22, the pace of operations was allowed to run down as aircraft were transferred back to Sabena's other routes, and by Jly. 28 the airlift was virtually at an end, although refugees were still flying back on scheduled services from the Congo.

In the peak period, Sabena committed its five Boeing 707s, eight DC-7Cs, 12 DC-6 and 6Bs and one DC-4 to the ferry operations between the Congo and Europe. In addition, the local fleet of four DC-4s, four Convair 440s and 13 DC-3s were used to bring refugees into the main departure airports of Leopoldville, Elisabethville and Kamina. To help cope with the enormous demand in the first few days, Sabena also chartered aircraft from at least 11 other airlines, and a contribution was made by the R.A.F. (see our issue for Jly. 29) and by the U.S.A.F.

All the Sabena aircraft were operated in all-economy configuration, but on most flights many children were carried, to bring the number of passengers well above the number of seats. For instance, the Boeing 707s had 188 seats but usually had at least 250 names on the passenger list; the record was 293 passengers and a crew of ten. A DC-3 carried 77 occupants on one flight. In all, Sabena had carried 25,711 passengers out of the Congo by Jly. 28, including 8,327 children and 1,888 infants. They were carried on 209 flights to Europe including 62 by Boeing 707s and the airlift flight hours totalled 6,217. Another 8,773 refugees were carried by other airlines in the same period.

Normal maintenance procedures and aircrew duty schedules were amended to allow each aircraft with one crew to make the fastest possible round trip between Brussels and the Congo. The Boeing 707s were averaging about 18 hr. for the return trip, including two hours on the ground at Leopoldville. DC-7s took about 14 hr. each way and DC-6s about 17 hr.

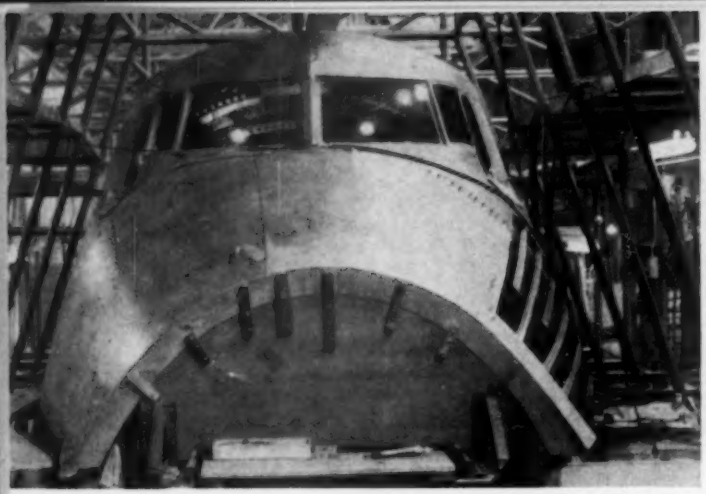
Over-flying Africa

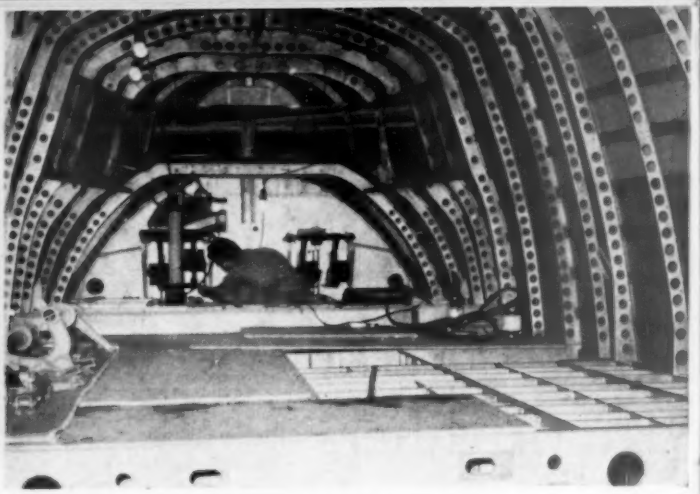
SOUTH AFRICAN AIRWAYS' provisional time-table for Boeing 707-344 services between the Union and the U.K. shows the effects both of landing restrictions in certain African areas and of the bigger capacity made available. Four return services a week will be operated by comparison with the present five with DC-7Bs, and the one west-coast service will be operated with only a single stop—at Brazzaville instead of Leopoldville—between Johannesburg and Rome.

The Great Circle distances on this run are 1,510 naut. miles from Johannesburg to Brazzaville and 2,767 naut. miles from Brazzaville to Rome. The aerodrome reference temperature at Brazzaville (Maya Maya) is just over 28° C. (82.5° F.) and the runway length is 7,545 ft. by comparison with Leopoldville's 15,420 ft.—so there may be payload restrictions on the northbound service.

The routeing for the other three services will be via Salisbury and Nairobi to Rome (2,905 naut. miles), with one operating via Athens to Rome.

S.A.A.'s 707s are laid out for 32 first-class and 93 economy class passengers—so there will be capacity for 500 passengers a week each way in comparison with 330-400 a week with the DC-7Bs.





TAKING SHAPE.—These photographs taken at Southend last week show the progress being made with the first new nose section for the Aviation Traders Carvair conversion of the DC-4. Nose doors will be fitted below the level of this new flight deck.

Air Transport . . . .

Canadian Veterans

RECENT accidents in Canada have regrettably accounted for two rare and distinguished veteran aircraft which were virtually unique in remaining in commercial service.

One of these was the corrugated Junkers F34, CF-AQW, of 1926 vintage, owned by Skyway Air Services and operating on floats with about 184 gal. of water on board for forest fire-fighting duties. Shortly after take-off, a wing struck the water during an attempted turn, and the aircraft cartwheeled and sank. Fortunately, the pilot escaped uninjured.

This was also the case in the second accident, which was to the Barkley-Grow T8P-1, CF-BLV, of Associated Airways, Ltd. This twin-engined type, which was built in limited numbers before World War II and resembles a Lockheed 10, was lifted off the runway prematurely, and swung back into the ground.

Fortunately, the balance of historic aircraft in Canada is being restored slightly by the reconstruction by engineer Wally Slye of one of the ex-Queen Charlotte Airways Supermarine Stranraer biplane flying boats. This is being equipped with two 1,250 b.h.p. Wright engines, in place of its original 1,050 b.h.p. Bristol Pegasus, for commercial use again.

The Air-freight Business

MORE information is now available about the two-level cargo transfer platform which is being developed by Canadair for the swing-tail CL-44. The design of such a platform is no simple business, since it has to become, so to speak, an extension of the aircraft fuselage, moving with it as fuelling loads, wind gusts and cargo movements alter its level and attitude. Reaction to these changes has to be accurate and more or less immediate.

In the Canadair system a truss is first attached to external lugs under the rear fuselage while the swing-tail is being opened and the transfer platform is then moved in on its castoring wheels to locate with this truss. The only direct contact of the platform with the aircraft is through rubber buffers on the forward face of the platform. Locating lugs are locked to the truss by pins and lateral arm vertical positioning is completed by manually operated screwjacks before steadying pads at the rear of the platform are lowered to prevent castor movement.

The platform itself is supported on its chassis by a single ball-joint at the rear and this incorporates a self-levelling jack which reacts to any movements of the aircraft floor level as shown by a sensing device.

A roller conveyor on the platform is set slightly above aircraft-hold level so that the loaded pallet (after being placed on the platform by a fork-lift truck) moves easily until about a third of its length is inside the fuselage. Hook carriers in the aircraft loading system then automatically engage with the pallet fittings. Similar roller conveyors are used at the lower level of the platform so that the bins or other containers can be moved into the lower rear freight hold.

T.W.A. is converting six of its 28 L-1649As into freighters and the first was due to enter all-cargo service this week. Special main (9-ft.-wide) and forward cargo-doors are being installed so that there can be simultaneous forward and rear loading and unloading. Similar modifications are being made to Lufthansa's L-1649As by Lockheed Aircraft Service at Ontario, California.

The 1959 values of U.K. imports and exports by air showed useful rises on those for the previous year. Exports were valued at £142.9 million (38% increase) and imports at £137.4 million (39% increase). The largest single category of air shipment was machinery. Nevertheless air cargo represented only 4.3% of the value of the total export shipments and only about 3.4% of the import value.

Cut-price Simulation

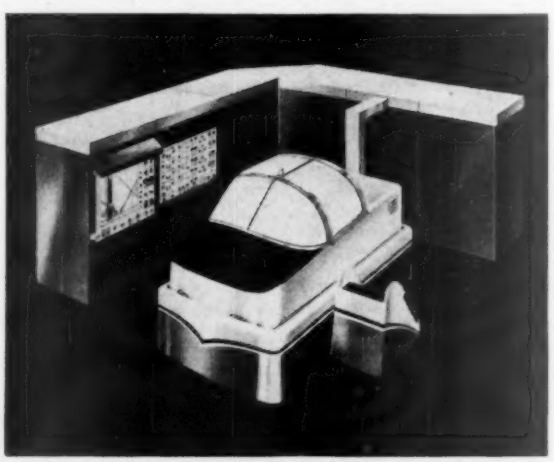
TO provide a simulator for jet transports within the financial reach of smaller operators, Link Division of General Precision, Inc. in New York has produced the Simulette. With a market price of about £225,000, the Simulette is designed to provide flight, instrument and navigation training based on the performance of a typical four-engined, swept-wing jet transport.

Whilst it does not serve the same purpose as a full flight simulator for a specific aircraft type, the Simulette can be used to give pilot training in the fields of Dutch-roll, swept-wing and engine-out performance, the operational use of controls and instruments and navigation problems and instrument approach procedures in congested terminal areas.

The layout generally follows that of the Link ME-1 simulator for the Cessna T-37A twin-jet trainer, with a two-seat cockpit for trainee and instructor side by side. The instructor's controls are on two panels, and can be operated while the trainee is under observation. Cockpit motion in pitch and roll is provided, and rough air can be simulated.

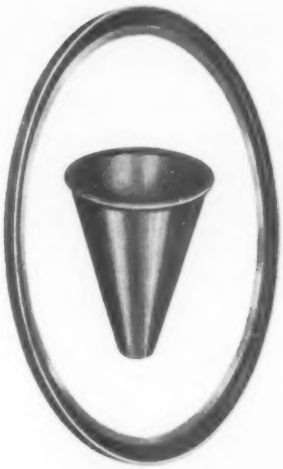
Basic design criteria of the Simulette provide for gross weights between 195,000 lb. and 280,000 lb., a maximum climb of 6,000 ft./min., and service ceiling of 40,000 ft. The take-off field elevation is adjustable up to 5,000 ft. and wind velocities up to 240 knots from any direction can be simulated. Standard radio navigation equipment provides for the simultaneous use of four stations, each providing GCA/ILS, OMNI, radio range or beacon, "located" anywhere in a 640,000 sq. mile area. The course recorder can be selected for large or small scale operation.

Operating cost of the Simulette is about $25 an hour including depreciation, spare parts and maintenance personnel.



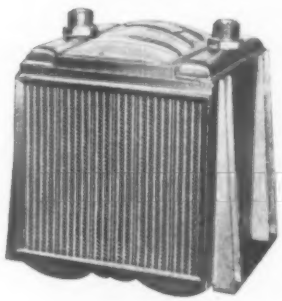
POCKET SIMULATOR.—The Link Aviation Simulette, described on this page, provides for general instruction in jet transport handling.

At Delaney Gallay

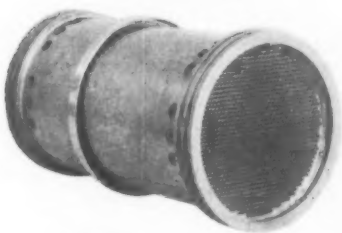


We can Flow Turn Nimonic, Stainless Steel, Light Alloy—

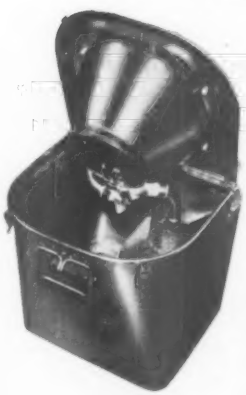
Flow turning makes lengthy and expensive tooling-up processes unnecessary. It enables us to produce such things as flanged rings, nose cones and similar items quickly and cheaply. It enables you to have 'one-off' at very short notice before production begins. Saves time. Saves money. Care to discuss?



and Braze very thin gauge Stainless Steel & Light Alloys



Light alloys we braze in the flux bath, stainless steel, nimonic and the like in our vacuum furnace. In the flux bath we can produce units smaller and lighter than can be produced by any other method. In the vacuum furnace we can often produce in stainless steel units of no greater weight than their equivalents in light alloy. For you?



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It is entirely self-contained yet flushes normally and is *odourless*. It can be lifted out and replaced with a fresh unit in about three minutes and requires no ground equipment. It weighs only 26 lb. yet is stainless steel throughout and is interchangeable with existing units. Full details?

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SUPERCARGO

In the Bumble Bee Nature has produced an unusually efficient flying machine with an astonishing load factor. No less than 46% of a laden Bumble's all-up weight is cargo, internally and externally carried. Evolution, unaided, has managed pretty well. Even so, AIR BP has given evolution a push in producing the SUPERFUELLER. Such is the march of progress that this technical tour-de-force has a load factor as high as 65%. True, it doesn't have to fly; but its semi-trailer light-alloy tank carries 10,000 imperial gallons *and* all operating stresses, eliminating the need for a chassis. Delivery matches capacity: twin hoses transfer 750 gallons per minute, through AIR BP-developed filtration and water separation systems of meticulously thorough performance. Road speed and handling are exceptional.

AIR BP Superfuellers are a new major force in the airlines' fight against "Time on the ground"—a promise of even faster turnround for all AIR BP customers.

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THE AVIATION SERVICE OF BRITISH PETROLEUM

The Fighting Services

M.E.A.F. Appointment

AIR MARSHAL SIR WILLIAM MACDONALD, K.C.B., C.B.E., D.F.C., has become the first Administrator of the Sovereign Base Areas of Akrotiri and Dhekilia in Cyprus. This appointment is in addition to his present post of Air Officer Commanding-in-Chief, Middle East Air Force, which he took over in December, 1958.

The Administrator of these Sovereign Areas, which came into being on Tuesday last when Cyprus became an independent republic, is empowered to make laws for peace, order and good government. In this capacity Air Marshal MacDonald is responsible directly to the Secretary of State for Air.

New C.-in-C. for Germany

AIR VICE-MARSHAL JOHN GRANDY, C.B., D.S.O., is to succeed Air Marshal Sir Humphrey Edwardes Jones, K.C.B., C.B.E., D.F.C., A.F.C., as Commander-in-Chief, R.A.F. Germany, in January of next year On taking up his new appointment, which also carries with it the NATO post of Commander, 2nd A.T.A.F., Air Vice-Marshal Grandy will have the acting rank of Air Marshal.

Appointed Commandant of the Central Fighter Establishment in December, 1954, Air Vice-Marshal Grandy later commanded Task-Force "Grapple," the series of nuclear tests conducted from Christmas Island in the Pacific. Since November, 1958, he has been Assistant Chief of the Air Staff (Operations) at the Air Ministry.

Battle of Britain Aerobatic Displays

SEVENTEEN aerobatic teams are to take part in flying displays at the 25 R.A.F. stations to be "at home" to the public on Saturday, Sept. 17, to commemorate the 20th anniversary of the Battle of Britain.

Two teams from No. 111 Squadron, one led by Sqn. Ldr. Peter Latham and the other led by Flt. Lt. L. A. Boyer, will open the displays at Gaydon and Coltishall before joining up to give a 14-aircraft display at Biggin Hill. The full Squadron will then perform at Bassingbourn, and finish the day with another performance over their home station of Wattisham.

The reserve Fighter Command aerobatic team provided by No. 92 Squadron (Sqn. Ldr. R. H. B. Dixon) at Middleton St. George will be seen at Acklington, Leuchars and Kinloss. Another Hunter F.6 team led by Sqn. Ldr. S. Chandler from No. 229 O.C.U. will perform over Chivenor and St. Athan.

Several types of Flying Training Command aircraft will be taking part in various shows. The Jet Provost team from the Central Flying School, Little Rissington, led by Flt. Lt. Roy Langstaff, will be at Biggin Hill and Tangmere, and four R.A.F. Flying College Meteor T.7s led by Flt. Lt. T. J. Doe will perform at Valley and Finningley.

The R.A.F. College, Cranwell, Vampire team led by Flt. Lt. Donald Ward will go to Norton and to Cottesmore, and Flt. Lt. George Black will lead the "Linton Blacks" from No. 1 F.T.S. at Linton-on-Ouse in displays at Biggin Hill and Leconfield. The Vampires of No. 5 F.T.S., Oakington, led by Flt. Lt. W. H. Croydon, will fly at Tangmere and Benson. No. 7 F.T.S.'s team from Valley is to perform at its home station and Shawbury under the leadership of Flt. Lt. P. Robert, and the Vampires of No. 8 F.T.S., led by Lieut. A. W. Compton, R.N., will be at Waterbeach and Biggin Hill.

No. 2 F.T.S.'s team of four Jet Provosts from Syerston, led by Flt Lt. W. D. P. Jones, is to fly at Valley and Jurby, and No. 6 F.T.S., Ternhill, will fly two Provosts in synchronized aerobatics at Aldergrove. The Central Navigation and Control School at Shawbury will put up three Provosts, two of them giving a synchronized display and the other doing solo aerobatics.

RESERVE TEAM.—No. 92 Squadron based at R.A.F. Middleton St. George is providing this year's Fighter Command reserve aerobatic team. Commanded by Sqn. Ldr. R. H. B. Dixon, the Squadron operates Hunter F.6s.

R.A.F. Appointments

THE following are among the recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. R. G. Dutton, D.S.O., D.F.C., to the Department of the Chief of the Air Staff.

Bomber Command: Wg. Cdr. H. Neubroch, O.B.E., to R.A.F. Upwood, to command No. 35 Squadron.

Fighter Command: Wg. Cdr. T. S. Wilkinson to R.A.F. Chivenor, as Senior Technical Officer of No. 229 Operational Conversion Unit.

Maintenance Command: Gp. Capt. R. E. W. Harland, to R.A.F. Swanton Morley, to command; Sqn. Ldr. R. A. Slater, D.F.C., A.F.C., to R.A.F. Boscombe Down, to command "D" Squadron, with the acting rank of Wg. Cdr.

Signals Command: Wg. Cdr. A. D. Panton, O.B.E., D.F.C., to Headquarters as Senior Personnel Staff Officer.

R.A.F. Germany: Wg. Cdr. H. C. McFarlane to R.A.F. Bruggen, to command the General Equipment Park.

Far East Air Force: Wg. Cdr. P. W. Gilpin, D.F.C., to Headquarters for planning duties.

Other Appointments: Wg. Cdr. E. Holden, D.F.C., to Headquarters, Allied Air Forces Central Europe, for planning duties; Wg. Cdr. S. R. Thomas, D.F.C., A.F.C., to Headquarters, Allied Air Forces Southern Europe, for planning and operation duties; Sqn. Ldr. W. L. McD. Scott to R.A.F. Luqa, to command No. 39 Squadron, with the acting rank of Wg. Cdr.

More Service News

No. 93 Squadron Reunion.—The first reunion dinner of No. 93 Squadron will take place at the Victory Club, 63-69 Seymour Street, London, W.2, on Saturday, Sept. 10. Will all past and present members of the Squadron who wish to attend please contact Flt. Lt. G. A. Talbot, Central Fighter Establishment, R.A.F. West Raynham, Fakenham, Norfolk.

Sassoon Trophy Presentation.—The C.-in-C., R.A.F. Germany, Air Marshal Sir Humphrey Edwardes Jones, recently presented the Sassoon Trophy for 1960 to No. 80 Squadron at R.A.F. Bruggen. This is the second time that the Squadron, commanded by Wg. Cdr. J. Hurry, D.S.O., D.F.C., has won the cup since the 2nd T.A.F. competition started in 1956.

AIR MOBILITY TRAINING.—Men of the 1st Battalion, The King's Regiment, using the specially designed Short lift, practise loading vehicles into a Transport Command Britannia at Nairobi. The transport had previously flown out the 1st Battalion, The Duke of Wellington's Regiment, from the U.K.

Military Aviation in Sudan

DURING its history, the Royal Air Force has had a long association with the largely arid area of the Sudan, dating back to soon after the First World War. A semi-permanent base was later built up at Khartoum, with which No. 47 Squadron became particularly associated from 1925 onward, until the start of World War II, when Sudan formed part of the supply route to vital Middle East areas.

R.A.F. units were withdrawn from Sudan some years before that country became an independent Republic in January, 1956, although staging post personnel remained up to that time, and a mutually useful association is continuing. Khartoum is still available for some R.A.F. transport flights, and a small Sudanese Air Force is being built up with the help of British military and civil personnel.

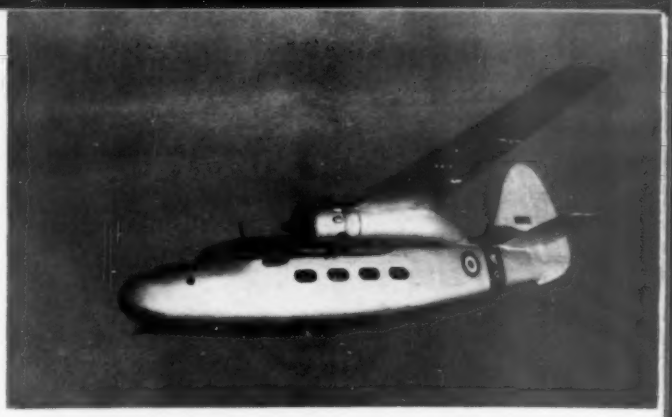
Training of Sudanese pilots started a couple of years before independence was achieved, when eight students went north

For *ab initio* and basic training, the Sudanese Air Force is equipped with the Egyptian-built Gomhuriah 2 (top), and the British Huntng Provost T.53. The Gomhuriah 2 has a 145 b.h.p. Continental engine.

to Egypt for *ab initio* instruction at the Bilbeis aviation academy. This began on the Gomhuriah, or locally built Bücker 181D Bestmann trainer and continued to the "wings" stage on Harvards and Doves. After about 250 hr. flying each, students were then sent to the U.K. for further training with the R.A.F. and also undertook the air weapons course at Leconfield on four Provost T.53s, which had previously been ordered for the Sudanese Air Force.

In addition to pilot training, Egypt also presented the Sudan with four Heliopolis-built Gomhuriah 2 trainers, which are all-wood types, powered by 145 b.h.p. Continental engines. These were used to lay the foundation of the new Sudanese Air Force, the Provosts being planned for use on more advanced training. The British aircraft were selected for general purpose duties, being capable of communications, armament training and other duties in addition to their main function of instructional flying.

The four Provost T.53s bearing the green, yellow and blue roundels and red rear fuselage bands of the Sudanese Air



Earlier this year, the Sudanese Air Force received two Hunting Pembroke C.55s for transport and training duties.

Force were flown out to Khartoum by ferry crews in July, 1957, but a few months later, in November, two were unfortunately destroyed in a mid-air collision, thus halving the effective aircrew strength of the young air force.

Although no R.A.F. units were immediately on hand to help overcome the effects of this serious setback, a Sudanese request for a British air adviser resulted in the arrival, on detachment, in April, 1958, of Wg. Cdr. J. C. Forbes, D.F.M., to Khartoum. He was accompanied by another R.A.F. qualified flying instructor, Flt. Lt. J. M. McMinn, to assist in setting up a training programme, and civilian servicing personnel—all ex-Service—were supplied by Airwork. Two more Provosts were obtained from the U.K. to replace those which had crashed.

At the same time, a twin-engined Pembroke C.54 was purchased from the Hunting company for communications, training, V.I.P. and military transport purposes. The Pembroke became a popular means of travel throughout the vast area of the country for the President of the Sudan Republic, Gen. Abboud; distinguished visitors such as the Emperor of Ethiopia; members of the Government and the military staff, who were usually flown by Wg. Cdr. Forbes. The senior Sudanese pilot, Major Awad Khalafalla, who had flown nearly 1,000 hours, also converted readily to the Pembroke.

Training of air and ground crews is continuing in Khartoum, although Sudanese personnel have also been sent abroad on various instructional courses. An offer by Ethiopia to train four pilots on E.A.F. Safirs to replace those personnel lost in the Provost collision was accepted by the S.A.F., and each is completing 200 hr. flying. A half-dozen or so Sudanese students are training with R.A.F. units in the U.K. on the Provost/Vampire sequence, and these will be the first of their countrymen to gain jet experience.

More Sudanese air force personnel are being trained in Yugoslavia, and flying instruction in Khartoum is being extended to include an eventual instrument rating. As one of the hottest places in the World, Khartoum does not often suffer instrument weather, but it is, of course, subject to dust storms, and in the south of Sudan, monsoon-type storms may be encountered.

Two more Pembroke C.55s were delivered by Fieldair Ltd., to the S.A.F. earlier this year, flying out via Dijon, Nice, Rome, Malta, El Adem, Cairo and Wadi Halfa. These versatile light transports maintain their good performance under tropical conditions, and offer a useful means of providing twin conversion.—JOHN FRICKER.

A last-minute check (right) at Wadi Halfa is made by W. Simmonds of Hunting Aircraft during the recent delivery of a Pembroke to Khartoum.

With this group of S.A.F. officers (left) on that occasion were Wg. Cdr. J. C. Forbes, D.F.M., R.A.F., fifth from right, the air adviser, and Mr. G. J. Clark of Huntings. On the extreme right is the senior S.A.F. pilot, Maj. Awad Khalafalla.

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Fast –
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(Two D.H. Gyron Junior engines)
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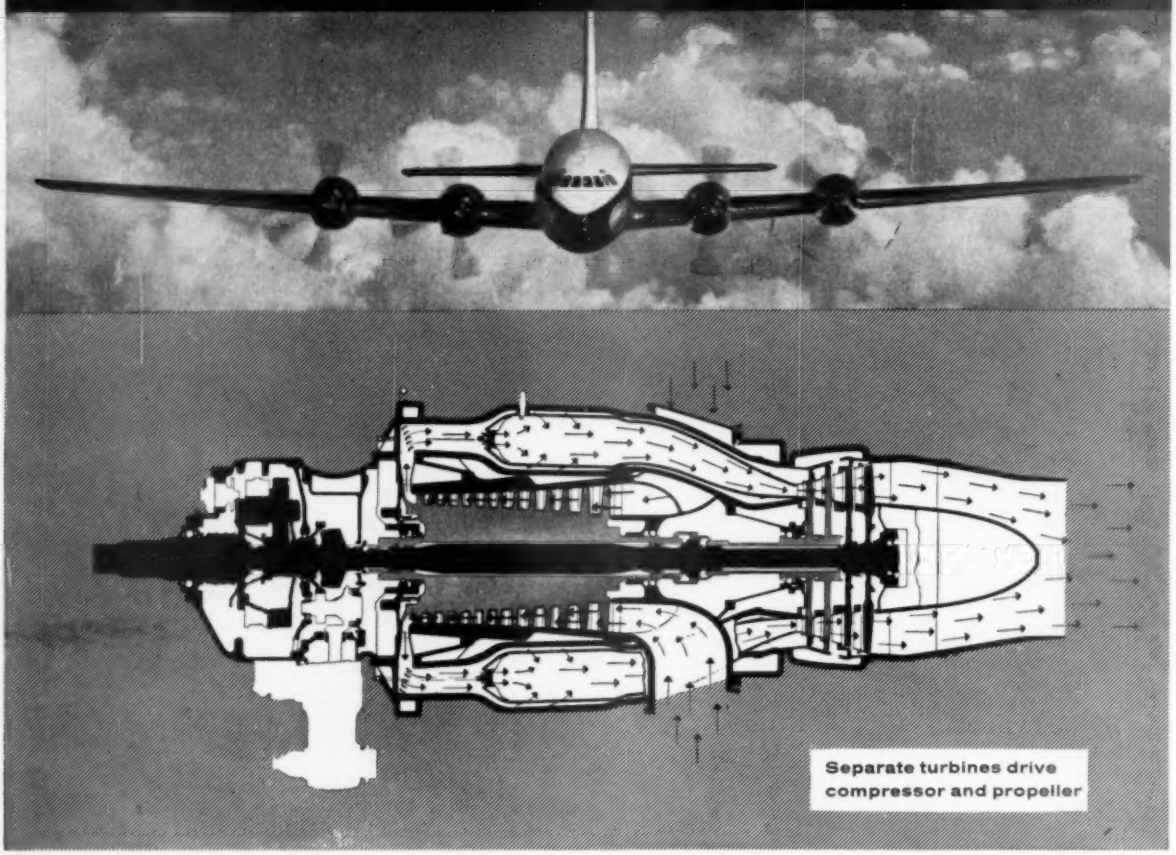
Proteus turboprop achieves 2,400-hours overhaul life— over 1,000,000 hours in service...



...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

The Proteus 705 turboprop powers the Britannia 102 airliners which ply BOAC's arduous Commonwealth routes. It was recently announced that this 3,890-hp aero-engine has been cleared for an overhaul life of 2,400 hours! This very impressive figure has been reached in just over three years service—a rate of increase never before achieved by any other engine, piston or gas turbine. And Proteus engines have now logged over 1,000,000 flying hours with 13 Airlines and RAF Transport Command—all over the world. During this time, Proteus development has continued and later versions deliver even more power for a lower specific fuel consumption.

But it is not only in the air that the Proteus has proved its success. For derivatives of this free-turbine engine, backed by great operational experience, are giving the same outstanding service as powerplants for fast patrol boats and for industrial electrical generators.

BRISTOL SIDDELEY ENGINES LIMITED

The Latest Drone Meteor

by E. H. Hall*

To provide easy access, the radio-control and auto-pilot equipment has been grouped in the nose, which has been lengthened and has a hinged top panel.

WITH the increase in the number of guided missiles under development comes a corresponding demand for representative targets either for test or service-acceptance firings. And although small high-performance targets specially designed for this purpose are available, the far greater proportion of targets used are surplus military aircraft converted to drones.

Latest aircraft to enter service as a drone is the Meteor U. Mk. 16—target version of the well-tried Gloster Meteor F. Mk. 8. Flight Refuelling, Ltd., of Blandford, Dorset, have been responsible for the design and conversion of this aircraft, as they were for its predecessor, the Meteor U. Mk. 15—a target version of the Meteor F. Mk. 4.

Conversion of the basic aircraft to its pilotless rôle consists of installing radio link equipment, an automatic pilot and trials instrumentation gear. This includes a camera system capable of recording the last stages of an attacking missile's flight to its target.

The converted aircraft can be flown either as a pilotless target, as a radio-controlled aircraft carrying a pilot for checking the control system or the range instrumentation, or finally as a normal piloted aircraft with the control system inoperative. Whereas in previous drone aircraft it has been the practice merely to provide suitable stowages for equipment wherever space permitted, the Meteor U. Mk. 16 has had considerable structural alterations introduced to cater for the specific and demanding requirements of target aircraft operation. This has improved the basic aircraft's flexibility and usefulness as a target, while retaining the original performance figures.

With the need for pre-trial servicing of the control equipment in mind, the nose section of the fuselage has been lengthened 30 inches to provide a compartment for the radio-controlled and auto-pilot units. A large forward-hinged door gives access to all of these units. To give greater endurance, important in development trials, the existing fuel system has been augmented by the addition of integral tanks in the mainplanes. Fuel is transferred by air pressurization from these tanks into a collector tank in the centre fuselage, and from there into the normal aircraft system. Partial pressure refuelling is fitted to reduce the turn-round time between trials.

Recording cameras are carried in wing-tip nacelles, each nacelle carrying two Wretar cameras. This type of camera, which has been developed by W.R.E. in Australia, covers a hemispherical field of vision of 180°, and each pair is mounted to give all-round coverage with one viewing above the wing and one below.

The nacelles are jettisonable and recoverable to enable film records of the trial to be saved should the target be damaged. The recovery system is installed in a detachable section of the outer wing inboard of the nacelles, and comprises a parachute system, a buoyancy bag and a homing beacon. On command, the wing-tip and its nacelle can be jettisoned and separation from the mainplane initiates the parachute sequence.

The system used to control the Meteor U. Mk. 16 in flight is that originally developed by the R.A.E. and used in all British targets. It centres on the use of a master controller who, by pressing buttons on a control panel, can transmit commands to the aircraft. During take-off and landing sequences the master controller transfers control to additional operators manning optical sights, who monitor the attitude of the aircraft in azimuth and pitch. The master controller can select a limited number of flight conditions by commands transmitted over a VHF link to a receiver in the aircraft, and hence to the auto-pilot.

In this particular drone the auto-pilot fitted is the Elliott B.4, and this will fly the aircraft in certain predetermined attitudes. The command signals may originate either from the ground transmitter via the radio link, or from a smaller version of the master controller's panel fitted in the cockpit. The selected attitude may be changed either by selection of a new attitude, or by pitch trim signals which alter the existing attitude within certain limits.

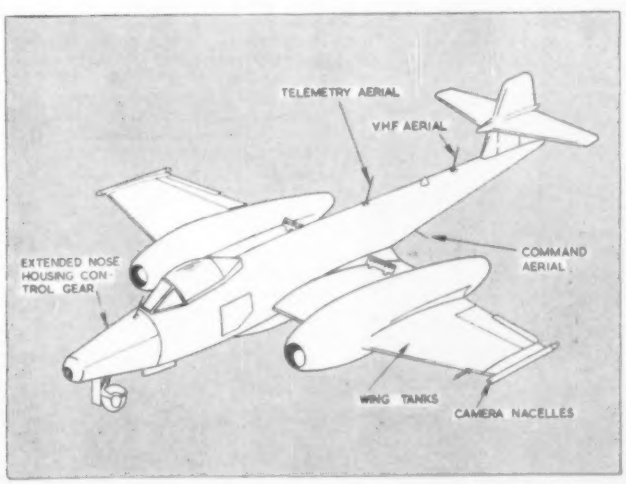
Transition between selected attitudes naturally involves a change of airspeed, and this may be accomplished by modification of the engine speed, change of aircraft pitch, or by operation of airbrakes, the method used resulting automatically from selection.

Most of the aircraft ancillary requirements are either selected before flight and left on or are operated automatically along with the flight attitude. That is to say, for example, a command to descend will cause the dive brake to operate. Certain electrical prohibitions, which act as safety measures, are built-in features of the commands, and may modify and, in certain circumstances, prohibit an attitude selection. Fixed attitudes each have an optimum airspeed, and since airspeed is largely a function of engine r.p.m., a system of automatic engine control, allied to variation of aircraft speed, is installed.

The aircraft controls are fitted with manual overrides so that with the auto-pilot disengaged, and with the various cockpit controls in their manual positions, the aircraft may be flown normally by a pilot. Alternatively the pilot can fly the aircraft via his control panel. As a safety precaution, override switches to cut-out the auto-pilot are fitted to the control column and throttle levers.

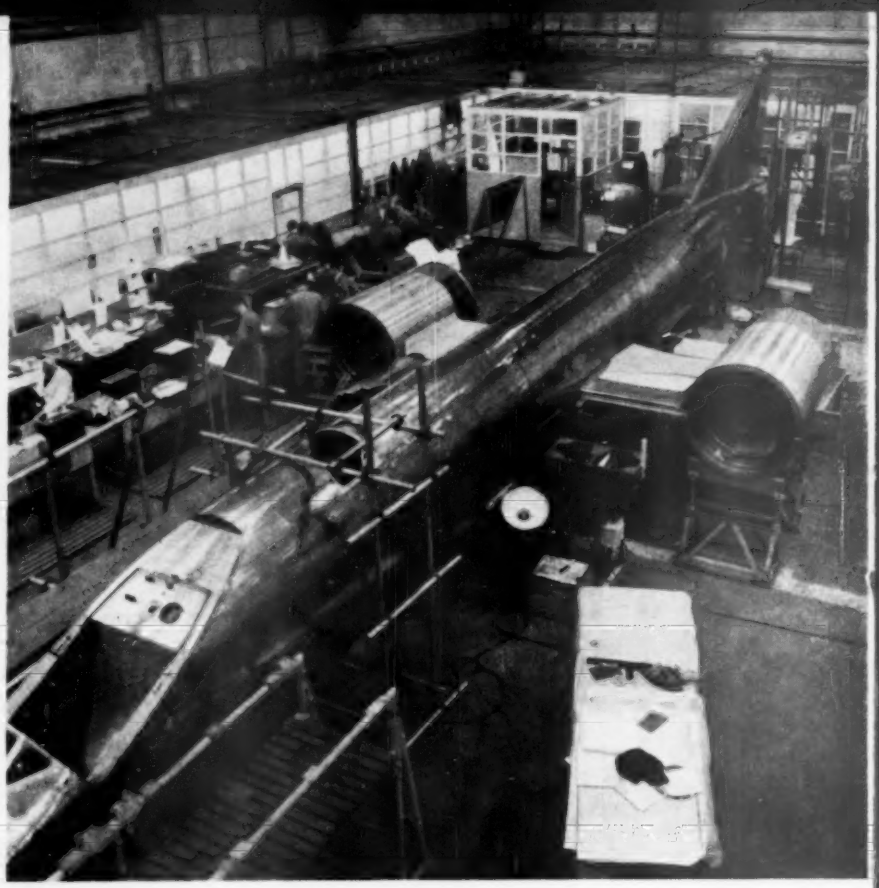
To provide performance and navigational information to the master controller, the aircraft is provided with a telemetry system, repeating to the controller the aircraft flight instrument readings, and a transponder beacon to assist tracking.

* Principal Designer, Flight Refuelling, Ltd.



Features of the Meteor U.Mk.16 drone, for the development of which Flight Refuelling, Ltd., has been responsible, are indicated in this diagram.

Developing Materials for the M=3 Bristol 188*



The Bristol Type 188 under construction at Filton.

IT has already been disclosed that the Bristol Type 188 under construction and due to fly soon is a supersonic research aircraft, designed to fly at speeds exceeding 1,500 m.p.h. and that it is of stainless steel welded construction. A general idea of its configuration has been given in photographs of a model (below) and more recently a photograph (above) has been released showing the aircraft on the shop floor in one of the sheds at Filton.

Behind those comparatively brief statements there lies a story of close co-operation between the aircraft designer and the Sheffield steel manufacturers—in this instance Firth-Vickers Stainless Steels, Ltd. First it was necessary to reach decisions about the materials to be employed for the major airframe structure and secondly to arrange the supply of the selected materials in the correct and precise condition of chemical composition, strength and size that must necessarily be specified. This latter aspect is often at the peril of the maintenance of the normal output of the supplier's main production lines, for reasons that will be detailed later.

Temperature Conditions

It is necessary to discriminate between the conditions that obtain when a conventional subsonic or low transonic aircraft is considered and those appropriate to an aircraft of the 188's performance. Of these, by far the most important are the effects of the temperature on the materials comprising the major airframe structure. Their significance is immediately apparent from the fact that parts of the structure of Type 188 experience temperatures upwards of 250° C. under the combined effects of kinetic heating and the heat generated by the engines and other installations.

When the full variation of atmospheric conditions of the intended flight plan is taken into account, temperatures of about 250° C. are likely to endure for such periods that the thinner portions of the structure will reach a steady condition. Thus it will be possible to explore structural behaviour under both transient and steady heating conditions.

* Specially contributed.

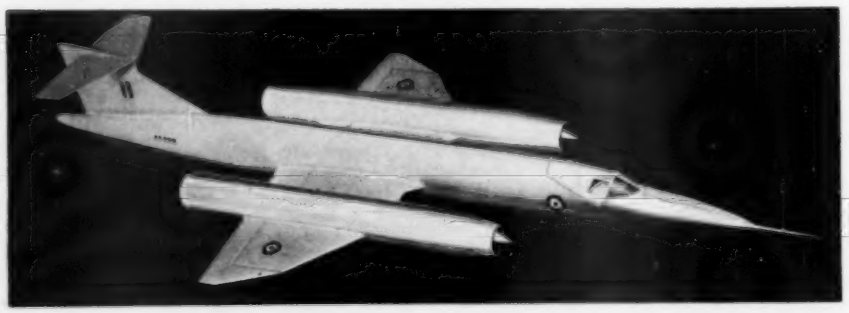
Material Selection

Under such conditions, the use of aluminium alloys is manifestly inadmissible, as on counts of both specific strength and specific stiffness their performance would have decreased markedly from the room temperature levels to a stage where efficient structural design is no longer possible. Hence the major structural material was clearly one of the varieties of stainless steel because carbon and low-alloy steels pose formidable questions of manufacture, condition of supply and protection against corrosion for the service life of the aircraft.

At the relevant time, indigenous production supplies of the sheet form of titanium were restricted to the commercially pure varieties; British alloy sheet materials were still in the development stages and foreign supplies barely out of them from the aspects of demonstrated consistency, adequacy of sheet size, thickness tolerance, flatness, etc.

The Sheet and Plate Form

The importance of the sheet form of material as constituting the envelope surface of any aircraft needs no emphasis, but it may be helpful to remark certain differences between the background of suppliers of the aluminium alloys and those of the stainless steels. While the large integrated sheet-manufacturing facilities of the former were probably planned against the stress of War-time exigencies of supply of aircraft sheet material to switch post-War to an inversion of the ratios of aircraft to commercial utilization, the stainless steel industry planned its corresponding sheet plant almost wholly against



A model of the 188 showing its general configuration.

commercial applications, probably mostly in the softer forms.

Generally speaking, this industry's major aircraft specialization has tended to be the supply of the bar and forging forms of material, for use in gas-turbine engines. Thus, the requirement for relatively small quantities of specialized forms of their sheet materials represented a rather major disturbance of their normal commercial activity, but one willingly accepted in the national interest.

The choice of the particular variety of stainless steel to be used had to satisfy the following criteria:—

(1) The highest possible elastic modulus to safeguard structural performance in overall stiffness and in local stiffness in the design of compression structure.

(2) Highest possible strength consistent with reasonable ductility and freedom from stress-corrosion troubles.

(3) Reasonable uniformity of mechanical properties as between longitudinal and transverse directions of loading and also as between loading in tension and compression.

(4) Simplicity of any heat-treatment procedures necessary to restore properties after cold working consequent upon the manipulation in aircraft fabrication processes.

(5) Availability of reasonably large sizes of sheets, to avoid unduly high numbers of joints, with a good standard of flatness, of surface finish, and of conformity to closer tolerances than are commercially acceptable.

(6) Minimum possible drop in properties at the operational temperatures involved.

The procedural difficulty that no suitable national material specifications existed and that special inspection controls would be necessary was accepted as appropriate to such a research aircraft.

Precipitation-hardening stainless steels were still in their infancy in this country and consideration of them was necessarily limited. Of the remaining materials, the complex 12% chromium stainless steel of the FV.448 type—originally developed as a creep-resisting steel for gas turbines—met most of the above requirements handsomely, but considerable difficulties arose in the manufacture of flat sheets of a sufficient size and in a very high strength heat-treated condition.

Very little forming can be done in this hardened condition and stretch flattening is impossible. The surface finish of the sheets as received is that appropriate to a hot-rolled and hardened and tempered steel product necessarily manufactured as individual sheets; and the flatness is only just adequate after hammer flattening by the maker. Nevertheless, this steel is most attractive structurally, and hence it has been used wherever these limitations are acceptable.

For some parts it is regarded as machining plate stock, to be subsequently milled and ground as appropriate to achieve the necessary close tolerances. Where thinner forms of this FV.448 material are applicable they are manufactured by the normal hot- and cold-rolling processes, with intermediate stretching at the appropriate stages to achieve the best flatness, prior to heat treatment in vertical ovens. Even these thinner materials are sometimes skin-ground all over before use.

For the major outside envelope of the fuselage structure, where double curvature forming is involved, it was decided that FV.448 steel would be unsuitable. Eventually the conclusion was reached that it was essential to utilize the inherent advantages of a cold-rolled form of material for this duty. A titanium stabilized 18% chromium 9% nickel steel—Firth-Vickers FDP was, in fact, chosen for such duties—accepting its somewhat less satisfactory physical properties.

However, merely to say that plate and sheet materials for particular areas of application could be selected on such general considerations would convey a very inadequate idea of the technical effort which both Bristol and Firth-Vickers still had to devote to the detailed assessment of the strengths of the material to be used in the structural design calculations.

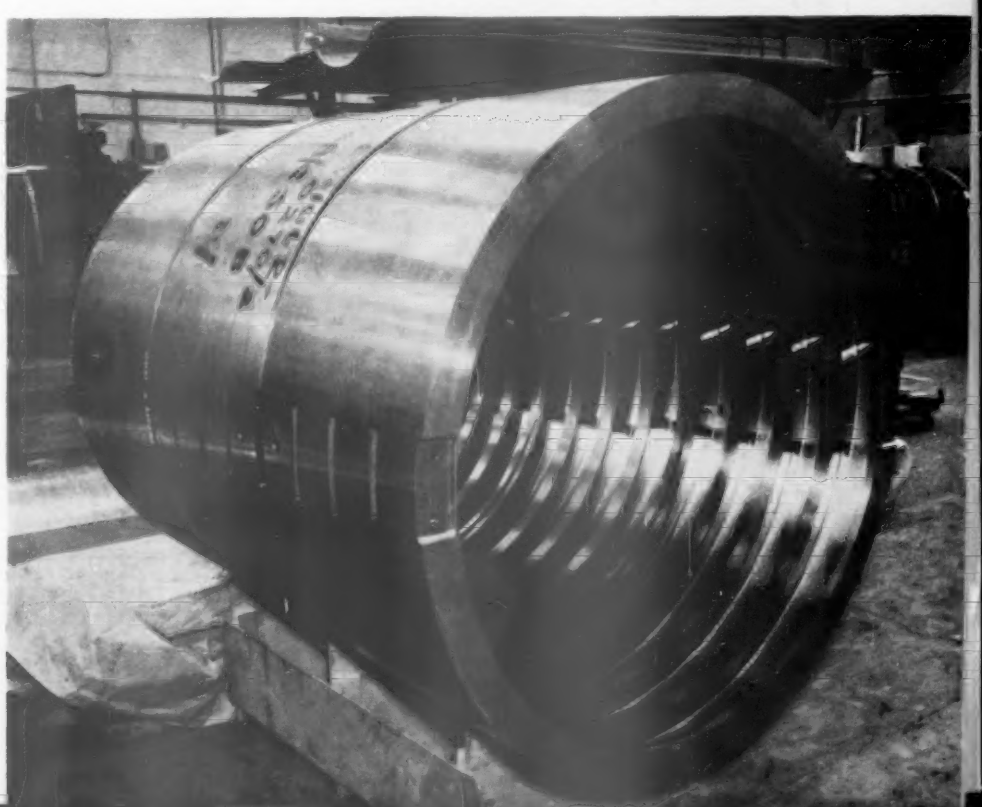
In the initial stages the airframe designers drew very heavily on the accumulated experience and data available from the laboratory facilities of Firth-Vickers, in respect of the general characteristics and potentialities of the various materials under scrutiny. The second stage became one of assessing how the detailed properties would be influenced by the particular manufacturing methods to be adopted, and most of this work was carried out at Bristol.

The FDP hard cold-rolled material furnishes a good example of the care necessary to achieve the desired results. This steel exhibits some directionality in elastic properties, particularly in regard to proof stresses in compression and tension. Although for many applications this difference is of no concern, airframe design requirements are such that it had to be extensively investigated and an improvement was obtained by heat treatment at 450-550° C.

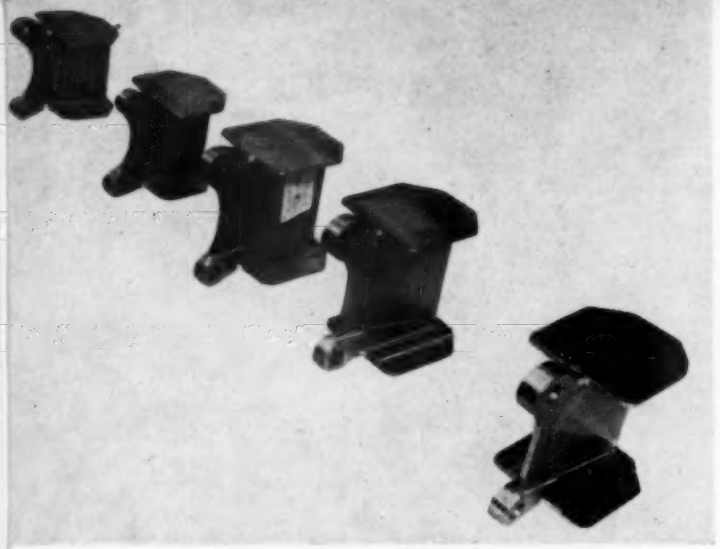
Again, some very detailed knowledge of thickness tolerances being achieved on sheet and strip was desirable, in order to safeguard weight. This was only to be achieved by Firth-Vickers taking measurements during representative production runs, for Bristol to assess statistically, before the full quantities of material could be ordered with assurance. Moreover, uniformity of mechanical properties depends on close control of thickness tolerances since these govern the amount of cold rolling applied.

It was necessary to investigate the metallurgical and strength characteristics appropriate to the hardened and tempered sheet and plate form for use as machining stock; earlier production of this steel having been confined to bars and forgings.

Apart from the establishment of typical design strength and modulus values in conditions of both tensile and compressive



Three cylindrical steel forgings bolted together end-wise to form the mid section of each engine nacelle.



A group of ultra-high-tensile wing-attachment forgings.

loadings in both directions of the sheet, decisions were taken regarding the performance of the steel under combined stress and corrosion, the best heat-treatment to ensure a safe metallurgical condition, and the precise composition to be adopted in order to keep the hardness of the welds down to a reasonable level. In fact, a carbon content somewhat lower than that customary in the bar and forging form became a special requirement for the sheet and plate form and a different heat treatment had to be used.

With the FV.448 material also it was proposed to apply a stress-relieving treatment as a last operation before component assembly, to counteract the effects of cold-work during manufacture of the aircraft parts and to realize by selection the best possible elastic modulus. So here again there was the situation that material was to be supplied in one condition for use in a slightly different one with the corresponding necessity for the two companies to evolve the specification governing the acceptance of the material both initially at Firth-Vickers' works and finally by selection at Bristol for incorporation into the aircraft.

Achievement of the necessary standards of flatness for the machining operations was no small matter either. It was soon established that the normal methods of manufacture did not yield an acceptable standard and that, as FV.448 is a stiff material, stretch-flattening is not a practicable proposition. Roller-levelling yields some improvement in converting sheets as hot-rolled and heat-treated into a shape with less random buckling and with more nearly uniform curvatures, but the degree of flatness is still not sufficient.

After much experimentation in the Firth-Vickers works by one of their parent companies—English Steel Corporation—and by a specialist equipment manufacturer, Joshua Bigwood and Son, Ltd., this problem was solved by adopting some of the techniques of armour-plate manufacture. This was mainly a combination of hardening and tempering by dipper-grid and block methods, with subsequent hammer-flattening. An interesting sidelight is that no specification for aircraft sheet material has ever contained any quantitative requirement for flatness as a characteristic. It was, in fact, necessary to evolve one—in terms of both general and local flatness.

Another, but later, interesting innovation was the introduction in both companies of ultrasonic methods of inspection of plate material, in order to ensure regularity of metallurgical cleanliness.

The Bar Form

In the form of rolled bars, the FV.448 composition is pre-eminently suitable for the general needs of Type 188 aircraft. Fortunately, in this instance, the peculiar difficulty associated with the sheet form does not apply. In bar form, it is the 18/8 material that is of limited application, due to the strength being that of the softened condition, to those parts where compatability with the corresponding sheet form, low magnetic properties, its higher corrosion resistance or more ready weldability are desirable. Thus FV.448 is chosen for the majority of parts produced from bar stock including fasteners in a wide range of sizes from "billets" for subsequent working at about 3 in. diameter to wires at about 0.1 in. diameter.

Beyond the use of FV.448 bar material in the general strength range of 70-85 tons/sq. in., the Type 188 aircraft was considered to justify the use of ultra-high-tensile low alloy steels, in the strength ranges 90-100 and 110-120 tons/sq. in. alike for bolts, bolt-like parts and special forgings. The particular virtue of ultra-high-tensile steels may be expressed as high strength for weight and size; for example, their use for bolts in lugs and fittings reduces the size of the fittings also and saves weight as well as room. While the FV.448 bar material was supplied directly by Firth-Vickers, the company arranged the supply of the forging form of it and of the U.H.T.S. in both bar and forging form from their parent companies, E.S.C. and Firth Brown.

The Forging Form

Some of the forgings are considered unusual and merit a little description. The inner wing, for example, is somewhat thin and an unusual method is used for the transfer of the loads from the outer wing across the engine nacelle. The mid-section of each engine nacelle consists of three machined cylindrical forgings of FV.448 steel bolted together end-wise.

These forgings were developed with Firth-Vickers and Firth Brown specially and are believed to be the largest aircraft steel forgings made to date. The weight of each as forged is between 3 and 4 tons and as supplied "gashed" is about 21 cwt. Inspection at Firth Brown is most comprehensive, including ultrasonic, electro-magnetic inspection and chemical etching, for the detection of any irregularities. Finished weight after final machining varies between 171 and 270 lb. for the three forgings.

Also, the Bristol 188 utilizes what are believed to be among the first ultra-high-tensile steel forgings to be embodied in a British aircraft. These are in 110-120 tons/sq. in. material in a composition generally similar to EN.40C and are made by

The individual nacelle forging as supplied "gashed."

Firth-Derihon. They form the attachments for the outer wing and are pocketed into the nacelle.

Another somewhat unusual forging in FV.448 is used for the keel boom of the aircraft. Here the problem is one of length required in relation to heat-treatment equipment available and the achievement of a straight forging after the heat-treatment processes.

In its final form for incorporation into the aircraft, the length required is a little short of 27 ft. and the thicknesses of the angle section vary from 0.45 in. to 0.1 in. and from 0.3 in. to 0.1 in. on the base and vertical flanges, the corresponding flange widths being of the order of 3 in. and 4 in. maximum respectively.

Making allowances for clamping and location during machining, for extraction of test pieces and for extra length required for manipulation during manufacture at English Steel Corporation, the original length is some 39 ft. and the original section is 4 in. x 3½ in., locally reduced to match the capacity of the resistance-heating equipment available. Rolled bar is used as the stock and the hardening operation is conducted in a

tunnel furnace specially constructed by E.S.C. The main heating is by resistance-heaters arranged round the walls of the tunnel.

Straightness is maintained by a load hydraulically applied to the bar in its expanded condition and maintained until it has cooled below its critical temperature. For tempering, the subsidiary resistance heaters are not used, the sole source being resistance-heating of the bar itself; the same hydraulic loading is used to maintain straightness.

Fasteners

Early in the development of the Type 188, serious consideration was given to the choice of materials for the various forms of fasteners required. In particular, it was desired to attain for the strength of solid rivets a considerable advance on the 35-45 tons/sq. in. typical of materials conventionally used for the joining of ferrous materials.

After trials of several possible materials it was found that FV.448 performed very well in the fully hardened and tempered conditions at 70-80 tons/sq. in. and that the rivets could be set relatively easily by squeeze or percussion methods, in sizes up to $\frac{1}{4}$ in. diameter. The limitation was in the load that could be applied and the ease and accessibility with which it could be brought to bear.

For applications where accessibility did not permit the loads required for solid-riveting to be applied, Brown Bros. Hi-Shear Rivets were selected for their easier setting characteristics. These also were machined from FV.448 bars or rods in a range of sizes from $\frac{1}{4}$ in. to $\frac{7}{16}$ in. diameter; for their collars a special titanium bearing 13% chromium steel Firth-Vickers FI(G) was adopted. This steel has been specially developed for golf-club heads and has excellent formability.

Sufficient has been said about fasteners already to emphasize that when an aircraft like the Type 188 demands unusual materials for the major structure, it is equally essential to develop a full range of fasteners in compatible materials. Then the criteria of performance for the needs of the specialist fastener manufacturer are often additional to those for the manufacture of the aircraft itself.

This was illustrated in the supply of coils of wire for the three-piece "blind" fastener selected, Aviation Developments' Jo-bolt. In order for the manufacture of the bolt and nut portions of it to be undertaken in the FV.448 material using the same high-speed cold-heading machines as are used for orthodox alloy steel materials, it was essential to control very closely the strength and condition of surface finish and of its lubrication. To achieve this control, close liaison was necessary with Firth-Vickers who supplied the cogged billet, with Hemmings—the specialist wire-drawer—as well as with Aviation Developments themselves.

Rather similar considerations prompted the supply of 3-in. billet material from Firth-Vickers of FV.448 and from Firth Brown of the ultra-high-tensile steel to the Unbrako Socket Screw Co. for the manufacture of the many special bolts and screws required. In view of the importance they attach to surface finish and its final lubrication and of the close tolerances they require for bolt and screw manufacture, their practice is to undertake all final rolling and drawing operations in their own mills.

Tubes

The Bristol 188 utilizes austenitic stainless steel piping for the hydraulic system used for its undercarriages, flaps and power-operated controls. This piping is mainly in the soft condition but, where geometry permits, a harder drawn variety is used.

The main needs are resistance to high working pressures, good fatigue performance under pulsating pressure, minimum weight and ease of manipulation. To provide the best performance a very high standard of finish—both in the bore and externally—and close adherence to minimum tolerances is the primary requirement. While the achievement of this desirable standard has been a matter for detailed discussion with the specialist tube makers, Accles and Pollock, it is largely the final tube-drawing that conditions these factors. It might be mentioned that they work from hollows extruded by Chesterfield Tube Co., from Firth-Vickers FDP austenitic stainless steel.

Materials Development

Extraordinary difficulties are faced by the aircraft manufacturer in adapting new materials to the specialized design requirements of a Mach 3 aircraft.

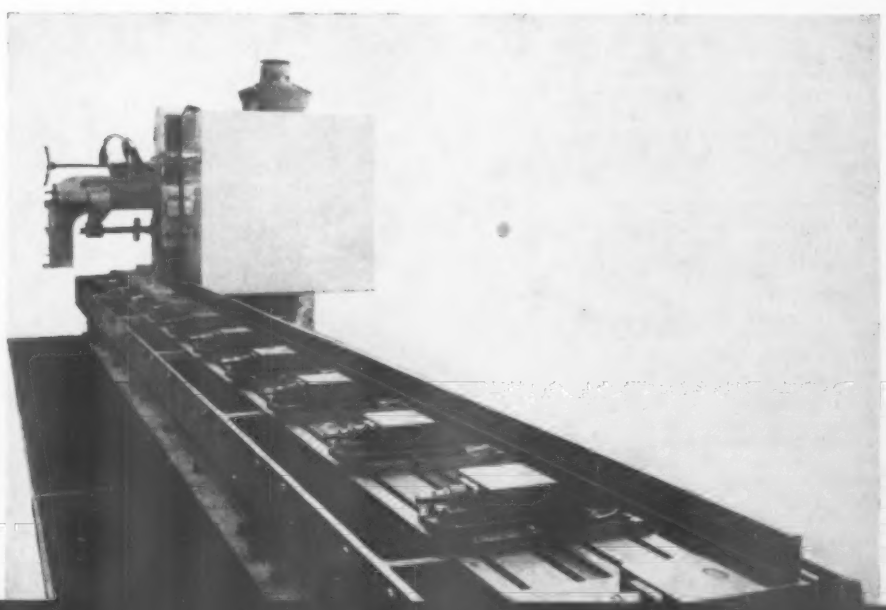
Having chosen a material on the basis of such evidence as is available, often incomplete at the time, production and fabricating experience must be obtained by a series of carefully planned development trials.

In this instance there was little previous experience of producing and handling high-strength steels in the form of flat sheets. The choice of FV.448 on the basis of its physical properties gave rise, later on, to some manufacturing difficulties in regard to the flat-rolled products, but proved to be an admirable decision in other ways.

The technical advisory staff of Firth-Vickers Stainless Steels was greatly involved in this work. The contribution they made might have been described at times as a form of negative salesmanship since every conceivable limitation of the chosen stainless steels was brought forward and thoroughly investigated, at Bristol or at Sheffield. As with all such projects, inevitably a stage is reached when the teams find themselves committed to a particular set of manufacturing proposals.

Notwithstanding that improved materials might be coming along in the steelworks, under the stimulus of the limitations revealed by the early trials, these must be put aside.

In this sense the high-strength stainless steels FV.520 and FSM.1 were developed by Firth-Vickers as a direct consequence of the decision to go ahead with the 188 and the experience gained in these development trials, but when they were perfected it was too late for them to be incorporated in this aircraft.



Right, is the finished form of the Bristol 188's keel boom, which is seen below during the machining operation. The original 39-ft. length of the FV.448 forging is reduced to about 27 ft. after allowances have been made for clamping and location during machining, for the extraction of test pieces, and for manipulation during manufacture.

Before the Britannia

by D. L. Brown, M.I.Mech.E., A.F.R.Ae.S.

IT is not sufficiently widely realized that the Britannia was the first and, for a period, the only aeroplane of any nationality to operate a regular non-stop service in both directions between London and New York.

About 17 years ago, a Government Committee, under the chairmanship of Lord Brabazon, was appointed to make recommendations regarding the types of civil aircraft likely to be required in the immediate post-War era. A number of specifications were drawn up, the first of which, named the Brabazon Type I, called for an aeroplane to operate a service non-stop between London and New York. As the War was then at its height, it was necessary to keep the bulk of the industry's design manpower employed exclusively upon military projects and for this reason the specification was issued in secrecy to the Bristol company.

The heaviest aircraft, British, American or German, then in service was the Short Stirling, with an all-up weight of 70,000 lb.: whereas the Brabazon specification necessitated a machine of at least twice and possibly three times that weight. Even the Douglas company of America, with considerable experience in the design of large aeroplanes, had failed to make a success of their latest and largest machine, the B-19 bomber. This machine, with a span of 212 ft., had been flying for just over a year and had failed to come up to its makers' expectations.

However, human nature being what it is, rumours soon began to circulate within the industry that a requirement had been issued for a post-War transatlantic civil aircraft. And certain firms began to sit up and take a lively, if unauthorized, interest in such an enticing project.

While, however, the rumours continued and gained momentum, it was virtually impossible to obtain access to the official specification.

The Bristol 167

The requirements of the Brabazon specification called for an aeroplane to carry a minimum of 25 passengers non-stop between London and New York—a distance of 3,443 statute miles. On this route, headwinds up to 100 m.p.h. are occasionally encountered but it was felt that reasonable regularity of service would be achieved if the machine were able to meet the requirements of range and payload against a constant headwind of 60 m.p.h. at any height between 8,000 and 25,000 ft. This required a still air range of over 4,500 miles, necessitating an aeroplane very much larger than anything envisaged at that date other than the bomber projects already mentioned and the American Consolidated XC99 then being designed.

Bristols tendered a design generally similar in size and dimensions to one of their bomber projects (see THE AEROPLANE AND ASTRONAUTICS, Dec. 25, 1959, p. 666), the main difference being the employment of tractor airscrews instead of the pushers envisaged for the bomber. Judged in the light of the knowledge and experience of 17 years ago—or, indeed, of the present day—the 167 was truly a formidable and courageous design. Compare the heaviest bomber then in service, having a span of 99 ft., a wing area of 1,464 sq. ft. and an a.u.w. of 70,000 lb., with the Bristol 167 having a span of 230 ft., a wing area of over 5,000 sq. ft. and an a.u.w. of over 200,000 lb.

The eight Bristol Centaurus engines were buried in the wings, coupled in pairs through gearboxes to drive through shafting four large contra-rotating propellers. Although these engines were 56 in. in diameter, the 31 ft. chord of the centre section together with a t/c of 21%, enabled them to be housed comfortably within the wing structure.

Both wing loading and power loading were similar to those of contemporary bombers and the estimated cruising speed was 270 m.p.h. at 25,000 ft. The machine was a mid-wing monoplane in which luxurious accommodation was provided for 45 passengers on the upper deck of the 20-ft. diameter pressurized fuselage.

In this connection it is interesting to note the modest requirements of the specification with regard to payload. It shows how little was, at that time, realized regarding the number of passengers who, after the War, would desire to cross the Atlantic by air. The Brabazon I was intended as the "Queen Elizabeth" of the air and yet was only required to carry 25 passengers.

Similarly, the specification for the Avro Tudor I, ordered at about the same time as an interim post-War type to operate over the North Atlantic via Shannon and Gander, called for accommodation for only 12 passengers.

The "Transatlantic Express"

Unable to obtain access to the official specification, yet nevertheless determined to submit a project design, Shorts had first to compile their own specification. The range was fixed but headwind and passenger accommodation had to be assumed. By luck or otherwise, Shorts allowed for the official headwind of 60 m.p.h.; and, in providing for two dozen passengers, they only just fell short of the official requirement.

Their project design, prepared in July, 1943, consisted of a low-wing monoplane powered by six Centaurus engines housed in conventional nacelles. It had a span of 184 ft., a wing area of 3,073 sq. ft. and an a.u.w. of 175,000 lb. The estimated cruising speed was 259 m.p.h. at 20,000 ft., giving a ground speed of under 200 m.p.h. against the assumed headwind and, therefore, a flight duration, without reserves, of over 17 hr. The fuselage was 16 ft. in diameter and the total wetted area of the aircraft was 11,330 sq. ft. as compared with 18,935 sq. ft. for the Bristol 167.

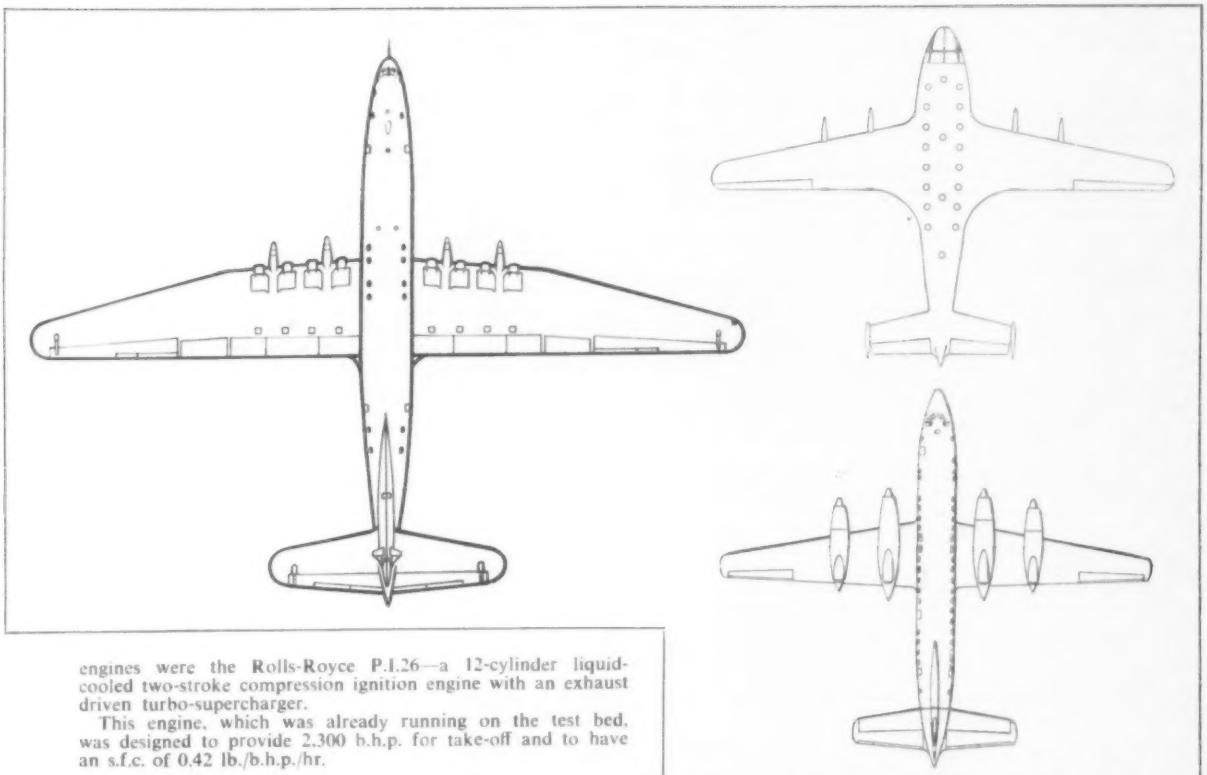
The Miles X11

Like Shorts, the Miles team had to make their own assumptions regarding headwind and payload. Their design, submitted early in 1943, assumed a continuous headwind of 50 m.p.h. and provided accommodation for 50 passengers.

As in the case of the Bristol 167, it envisaged eight buried engines coupled in pairs and driving four tractor airscrews; but beyond this, the Miles design had practically nothing in common with its two competitors, being based on an entirely different approach to the problem. Taking as the dominating requirement the fact that the machine had to provide a very long range against exceptionally strong headwinds, it seemed evident that a high cruising speed was essential if an inordinate duration of flight was to be avoided. Instead, therefore, of adopting the low wing loading, high power loading and relatively low speed of contemporary bombers, the Miles design was much smaller than either of its competitors, incorporating what was then a very high wing loading, a low power loading, a thin laminar flow wing and a performance comparable with contemporary fighters.

The span was 150 ft., the wing area 2,350 sq. ft.—less than that of the Bristol 167—and the wetted area of fuselage was 3,950 sq. ft. as compared with 7,000 sq. ft. of the Bristol. With practically the same cruising power as the Bristol, the estimated cruising speed was 350 m.p.h. at 25,000 ft. giving a flight duration of 11.9 hr. against the "official" headwind. The

This Miles X11 project of 1943 was designed for operations over the North Atlantic. It was considerably faster than competitive projects, thanks to the use of a laminar-flow wing and generally clean design.



These three drawings compare, to a common scale, the Bristol 167 Brabazon (top left) designed to a specification to carry 25 passengers across the North Atlantic non-stop; the Miles X11 (top) which would have carried 50 passengers; and the Britannia 310 (above) which to-day accommodates 149 passengers.

engines were the Rolls-Royce P.1.26—a 12-cylinder liquid-cooled two-stroke compression ignition engine with an exhaust driven turbo-supercharger.

This engine, which was already running on the test bed, was designed to provide 2,300 b.h.p. for take-off and to have an s.f.c. of 0.42 lb./b.h.p./hr.

The Short Tailless

Although not submitted with the three projects already described, it is of interest to note that the following year Shorts, at the suggestion of Prof. G. T. R. Hill, of Pterodactyl fame, prepared a design study for a tailless aircraft based on the same specification that they had assumed for their Brabazon tender.

On paper the tailless configuration appeared to offer substantial advantages over the orthodox layout both as regards structure weight and drag. As a result, Shorts considered that their tailless project would carry 28,950 lb. as compared with 22,450 lb. for their orthodox design, while cruising 28 m.p.h. faster. The powerplant consisted of five Rolls-Royce 46H24 engines buried in the wing and driving contra-rotating pusher airscrews.

This engine, then in the development stage, was a 24-cylinder liquid-cooled engine designed to give 3,300 b.h.p. for take-off and to have a s.f.c. of 0.45 lb./b.h.p./hr.

Of course, at that date, the shortcomings of the tailless layout, especially in respect of low CL max, limited C.G. range and indifferent handling characteristics were not fully appreciated. The seemingly encouraging results obtained by Northrop had not been countered by the experience gained later with the A.W.52 and D.H. 108 tailless research aircraft and therefore, on paper at least, the tailless configuration appeared to be an attractive proposition.

TABLE 1.

	Bristol 167	*Short Orthodox*	*Miles X.11*	*Short Tailless*
A.U.W., lb. ..	240,000	175,000	165,000	185,000
Wing area, sq. ft. ..	5,190	3,073	2,350	5,300
Wing loading, lb./sq. ft.	46.5	56.9	70.2	34.9
Engines	8 Centaurus buried and geared	6 Centaurus in nacelles	8 Rolls-Royce P.1.26 buried and geared	5 Rolls-Royce 46H24 buried
Take off, b.h.p. ..	19,200	14,400	18,400	16,500
Power loading, lb./b.h.p.	12.5	12.15	8.96	11.2
W^2/SP	581	690	630	392
Span, ft.	230	184	150	176
Aspect ratio ..	10.1	11.0	9.55	5.85
Root t/c	0.21	—	0.18	0.22
Estimated cruising speed, m.p.h.	270	259	350	287
Flight time against headwind of 60 m.p.h., hrs.	16.4	17.35	11.9	15.2
Firm's estimated profile drag at 100 ft./sec., lb.	1,100	803	425	698
Seating capacity ..	45	24	50	34

After examining the three tenders, the Ministry came to the conclusion that none of them would have the required range at 8,000 ft. They thought, however, that at 25,000 ft. the Bristol 167 would carry 33 passengers and that the Miles X11, if cruised at 270 m.p.h. at 25,000 ft., would carry 31 passengers.

In the opinion of the Ministry, no machine of less than 190,000 lb. a.u.w. could carry the required crew, equipment and payload, amounting to a total of 20,500 lb. for the specified range. This automatically eliminated the Short and Miles designs and confirmed the Ministry in the decision, already made on policy grounds, to order the Bristol 167. Moreover, the Miles project was based upon an engine then under development but not yet available; which the Ministry regarded as a gamble they were not prepared to take.

Thus, the decision was made to go ahead, as planned, with the Bristol 167.

The Revised Specification

However, the fact still remained that it would not fulfil the specification requirements. Well, if the mountain will not come to Mohammed . . . . So the specification was amended, the headwind being reduced—presumably with Divine co-operation!

As the design progressed, it soon became evident that, not only would the machine be unable to meet the range against the headwind originally specified but, in addition, relaxations would have to be made in respect of cruising speed and take-off distance.

Specification 2/44 (Issue II), issued on Aug. 15, 1946, called for accommodation for 50 passengers, a total payload of 17,500 lb. with a range of 3,000 nautical miles against a headwind of 43 kt. at any height between 8,000 and 25,000 ft. The required cruising speed was 186 kt. at 8,000 ft. increasing to 217 kt. at 25,000 ft. This, be it noted, necessitated an endurance, exclusive of reserves, of 21 hr. at the lower altitude!

In addition, due to increased tankage and failure to achieve the anticipated structure weight, the a.u.w. had substantially

increased and also, therefore, the wing-loading. However, an extra 100 b.h.p. per engine was now available at take off: but even so W^2/SP had increased from 581 to 805, necessitating a relaxation in the take-off requirements. Here it may be observed that, three years previously, the figures of 690 and 630 for the Short and Miles projects, respectively, had been deemed by the Ministry to give an unacceptable figure for take off.

The revised take-off requirement now called for the machine to clear 50 ft. against a 4-kt. wind in 1,800 yd., as compared with the original figure of 1,500 yd. in still air. The machine was, however, required to come to rest within 800 yd. of touching down against a 4-kt. wind at maximum landing weight and without the use of reverse pitch propellers.

The Bristol 167 Mark II

Meanwhile, the engine division of the Bristol company had been pressing on with the development of the Proteus turboprop engine and by 1946 it was hoped that the enhanced performance obtainable with this type of engine might well prove to be the salvation of the 167. The great increase in cruising power provided by the Proteus would in turn increase the cruising speed to something of the order of 330 m.p.h.: and the resultant decrease in the duration required for the flight would more than offset the higher s.f.c. of the developed Proteus turboprop.

This increase in cruising speed was a factor of considerable importance on a route on which such powerful headwinds were not infrequently encountered. In point of fact, the performance now envisaged for the 167 Mark II was approaching that chosen for the Miles X.11 project of some three years earlier.

Such were the anticipated benefits to be gained by the installation of the Proteus engine that the machine was now deemed capable of carrying 68 passengers against a headwind of 70 m.p.h. Since this headwind was 10 m.p.h. more than that originally specified and, indeed, 20 m.p.h. more than the figure quoted in the revised specification, it would appear that the winds to be encountered were in some mysterious way a function of the design of aircraft and of the types of engine available.

When the Mark I first flew in 1949, its bare weight had risen and its cruising speed was decreased so much that it could no longer be regarded as capable of fulfilling the purpose for which it had been designed. Against a 60-m.p.h. headwind, the flight time was now up to 18.2 hr., for which there was insufficient fuel.

However, the Mark II—thanks entirely to its turboprop engines—offered a reasonable chance of fulfilling the requirements, and it is interesting to note that the fuel and oil amounted to 35.8% of the a.u.w. as compared with 35.3% for the Miles X.11.

Had the Mark II been completed and achieved its estimated performance, the substitution of turboprop engines for piston engines would have resulted in an increase of some 80 m.p.h. in the cruising speed, thus reducing the flight time by 4¼ hr. and, in addition, would have increased the payload 3,500 lb. On the other hand, given a high cruising speed, it should not have been necessary to have an aeroplane of anything like 290,000 lb. a.u.w. in order to carry a worthwhile payload nonstop between London and New York. This was the philosophy of the Miles project and has since been proven by the Bristol Britannia.

With regard to the Brabazon Mark I, it was surely evident from the start that it could never hope to operate against headwinds of 60 m.p.h. As for the Mark II, while, as already shown, it might have proved to be a useful aeroplane, the fact that it was never completed renders its anticipated performance of little more than academic interest.

The purpose of this article is to give some account of the historical sequence of events which, so many years later, led to Great Britain—and, in fact, to the Bristol company—building the first direct transatlantic airliner.

But first it is worth recording that while all this was going on, yet another uninvited transatlantic design had been submitted to M.A.P. offering a really staggering performance. This was in May, 1945, when the firm of Power Jets, led by Air Cdre. Frank (now Sir Frank) Whittle, submitted a project design for a transatlantic civil transport powered by four ducted fan engines and designed for a still-air range of 5,280 miles at a cruising speed of 470 m.p.h. at 45,000 ft., carrying a payload of 20,000 lb. (see THE AEROPLANE AND ASTRONAUTICS of Mar. 13, 1959, p. 316).

Characteristically, the Ministry considered that no future civil aircraft would be required to cruise at 470 m.p.h. and that it would be virtually impossible to provide a suitable pressurized cabin. The Whittle design was therefore rejected and the Ministry continued to juggle with headwinds and to expend millions of public money upon a machine designed to cruise at exactly half the speed offered by Whittle.

We will now return to the Britannia which, from a very different beginning, was ultimately to develop into the machine to do the job on which so much time, thought and money had already been expended.

The M.R.E. Specification

One of the anticipated requirements of B.O.A.C. given to the Brabazon Committee was called the Long Range Empire type. This called for a transport aircraft of about 100,000 lb. a.u.w. suitable for operating on stage lengths up to 2,500 statute miles necessitating a still-air range of 3,500 miles. This was agreed by the Brabazon Committee and passed to the Ministry of Aircraft Production in November, 1944, under the designation of Brabazon Type III.

Apart from an uninvited tender by Miles, the firm of Avro was selected to tender for the Brabazon III and put forward a project design known as the Avro 693. This was subsequently discussed and modified but various delays occurred and by 1946 B.O.A.C. decided that they would prefer to have a machine suitable for economical operation over shorter ranges for which the Brabazon III was unsuitable. They therefore drew up the requirements for an aircraft known as the Medium Range Empire type or M.R.E. and this was passed to M.A.P. who issued it as Specification 2/47.

This called for a four-engined machine to carry 32 passengers and 2,750 lb. of freight over stage lengths up to 1,354 miles at a cruising speed of 320 m.p.h. at 20,000 ft. With the necessary fuel reserves, this meant a maximum still-air range of 2,500 miles. The machine was required to unstick in still air in a distance of 950 yd. and to land over 50 ft. in 850 yd. without the use of reverse pitch propellers. It was also required to be controllable with both engines out on one side, even during take-off.

The Britannia

As the War was over, 10 companies were invited to tender and project designs were submitted by Armstrong Whitworth, Blackburn, Bristol, Handley Page and Avro. Of these, the Bristol Type 175 appeared on paper to be the best, though it was not considered by B.O.A.C. to meet the specified requirements in every respect. It was to be powered by four Centaurus engines. The subsequent history of the machine which ultimately became the Britannia as we know it today, was given in THE AEROPLANE of Feb. 1, 1957. It first flew in August, 1952.

By a steady process of enlargement and stretching, the Britannia 300 Series was gradually evolved and provided for the first time an aeroplane capable of operating a regular nonstop service between London and New York while carrying a worthwhile payload.

The a.u.w. grew from 94,000 lb. for the project design of 1947 to 185,000 lb. for the Britannia 310 of a decade later. Thus the first successful transatlantic transport aircraft was in fact, of substantially the same size, power, weight and performance as that envisaged 14 years earlier by Miles and rejected as inadequate by the then Ministry of Aircraft Production.

TABLE 2.

	Miles X.11 project of 1943	*Britannia 300 of 1957*
A.U.W., lb.	164,000	175,000
B.H.P.	17,600	16,480
Span, ft. in.	150 0	142 3½
Length, ft. in.	110 0	124 3
Wing area, sq. ft.	2,350	2,075
Aspect ratio	9.6	9.75
Cruising speed, m.p.h.	350	345
Fuel capacity, galls.	7,400	8,580
Payload corresponding to still-air range of 3,450 miles, lb.	24,000	28,000

Table 2 shows the great similarity between the Miles X.11 project of 1943 and the long-range Britannia of today. It also shows, in terms of performance actually achieved, how completely the Bristol Aeroplane Company have made up for the lack of success of the 167—a design in which, be it noted, they were whole heartedly supported by the Ministry of Aircraft Production.

It also vindicates beyond doubt the philosophy underlying the design of the Miles project. And, although many years have passed and some millions of pounds have been spent since the original project designs were submitted to those charged with the task of assessing and judging between them, it is pleasant to reflect that, thanks to the gas turbine, the ultimate success was an all-British product.

But think also of what the Miles X.11, if ordered in 1943, could be doing today powered by four Proteus or Tynes; or, better still, what could have been achieved by the Power Jets design if ordered in 1945.

Military Uses of Space

In the absence of international agreement the present decade may see the emergence of military space-vehicles of many kinds. Kenneth Gatland outlines the problem.

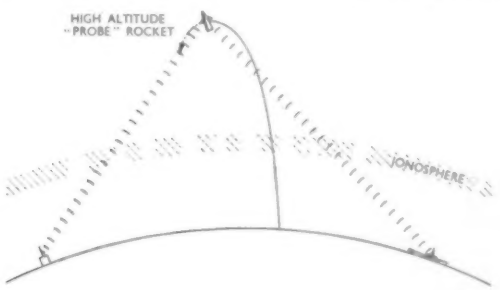
ONE aspect of astronautics unlikely to have arisen at this week's Astronautical Congress in Stockholm concerns the military uses of space. The I.A.F., which restricts its activities to "the peaceful development of astronautics," was to hear papers concerned with scientific and civil space-projects only and the closest it was likely to have got to military matters will have been during the Space-Law Colloquium which has been discussing "The International Control of Outer Space."

Nevertheless, concern that nuclear weapons may be launched into orbit in bombardment satellites has already been raised in international debate at the now abandoned disarmament conference in Geneva, and the increasing enthusiasm in America for reconnaissance satellites, to replace the more vulnerable reconnaissance aircraft, makes it necessary for us to investigate what this new trend in military outlook may involve.

Reconnaissance from Orbit

Table 1 lists a number of possible military space systems ranging from reconnaissance and surveillance satellites to the so-called "jump-down" bomb. Some of these devices have the prospect of becoming operational within a few years, while others are clearly in the earliest stage of research and development.

In the first category are comparatively straightforward developments of existing techniques. A probe rocket launched on a ballistic trajectory of a few hours' duration, for example, might become an excellent method of point-to-point communication when other means of communication have broken down following a nuclear attack.



Method of establishing short-duration communications following ionospheric interference, by means of high-altitude "probe" rocket.

Another simple device might be a satellite acting as a communications link between sonobuoys strategically placed for the detection of submerged submarines. It might even be possible to launch the sonobuoys into distant waters in the nose-cones of ballistic rockets.

However, it is the reconnaissance satellite about which most has been heard in recent months, and much more is likely to be heard of it in the future. Experimental versions of the Midas (Military Defence Alarm System) satellite are already in orbit, and shortly we are to witness the launching of the first Samos reconnaissance satellites from sites on America's west coast (THE AEROPLANE AND ASTRONAUTICS, Jly. 15, 1960, p. 89). At present, both these systems are in an early development stage but, within two to three years, the U.S.A.F. is confident that strings of these satellites will be operational in polar orbits, bringing the entire World under the scrutiny of the most advanced optical, infra-red and radar equipment.

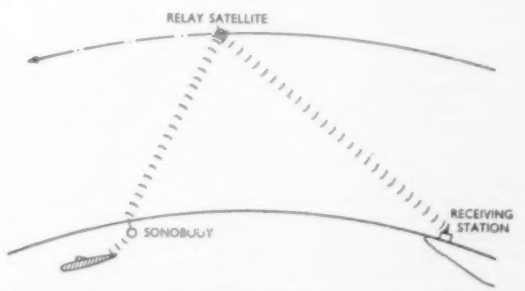
In a previous article, the wisdom of launching reconnaissance satellites into polar orbits, at the present delicate stage of East-West relations, was considered in some detail (THE AEROPLANE AND ASTRONAUTICS, Jne. 3, 1960, pp. 678-679). Specifically, it was thought that orbits which crossed Soviet territory would be considered in the same light as the flight of the U-2 reconnaissance aircraft and would raise further problems in the political arena.

If, on the other hand, the operation of such satellites is allowed to proceed without recourse to the United Nations or direct counter-action against them, a precedent will have been established and both East and West might resolve to carry on such operations for reasons of *mutual* security. In other words, if satellites of this kind are considered "useful" as an extension of each other's advance warning systems, their launching in the future may become as familiar as those of the scientific satellites, which have enjoyed the "freedom of space" ever since Sputnik I was sent into orbit during the International Geophysical Year.

The alternative would be for Russia to attempt the physical destruction of each offending American satellite—an expensive and somewhat tedious procedure.

Identification Problems

However this situation may eventually develop, it is fairly clear that a complicated problem may arise because military operations might grow from these beginnings to include the use of nuclear weapons in space. Even in the event of international agreement to limit the use of space for peaceful purposes only, military satellites *could* be sent into orbit under the guise of "peaceful" satellites. The only practical way of ensuring that this did not happen would be to allow mutual inspection of launching sites, a proposition unlikely to appeal to the Russians.



Detection of submerged submarines by sonobuoy in conjunction with radio-repeater satellite.

An alternative might be to establish an international tracking network for the purpose of maintaining full records of all satellites in orbit and to catalogue each new launching. In this, all nations would be required to furnish details of each new satellite launched.

If it were possible to extend ground tracking facilities to include inspection in orbit, it might be possible to obtain a clear idea of the intentions of an unscheduled satellite—either from the radiation it emits, from details of its configuration, or its external equipment, etc. However, if we postulate a chain of inspection satellites girdling the equator to photograph and possibly radar-measure such "mystery objects" in orbit, not only would we find that the vehicle must pass very close

TABLE 1: POSSIBLE MILITARY SPACE SYSTEMS

Reconnaissance and surveillance.—Inspection of foreign territories by close-orbit satellites using optical (TV or recoverable film cameras), infra-red and radar equipment. Inspection of hostile missile launching by IR radiation. Inspection of localized areas (e.g., during operation of a naval task force) by probe rockets on arching trajectory.

Navigation.—Accurate positional "fix" via satellites for surface-launched, mobile IRBMs or ICBMs (e.g., launching from submarines and aircraft).

Communications.—Rapid relay of surveillance information back to home stations by radio-repeater satellites; communication between military groups widely dispersed around the World. Limited-duration transmission between surface stations following nuclear interference with ionosphere—by communications rockets launched on high-altitude arching trajectory.

Meteorology.—Routine inspection of global weather conditions by close-orbit satellites (easily disguised for surveillance purposes).

Satellite Inspection.—Arching missile, or equator-orbiting satellites, to locate, photograph and/or radar-measure unscheduled space-vehicles in orbit; later, manned rendezvous satelloids for physical inspection.

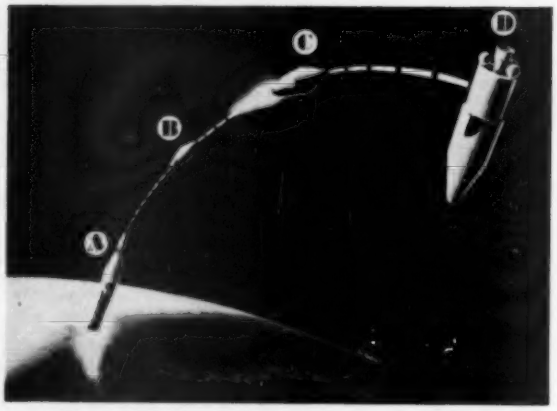
Orbital "Jump-down" Bomb.—Simple orbital ballistic device cut-down on surface target on command, but restricted to operation in orbital plane.

Orbital Glide Bomb.—Development of "jump-down" bomb to permit extension of lateral range by hypersonic glide.

Anti-orbital.—Identification, tracking and destruction of "hostile" space-vehicles in orbit by counter-launched weapon.

Orbital decoy.—Spurious orbital device to confuse ground intelligence—may embody transmitters of various kinds.

Anti-missile (orbit stored).—Anti-missile missiles strategically placed in orbit to "jump down" on IRBM and ICBM warheads near zenith of trajectory.



Operation of the Midas (Missile Defense Alarm System) satellite. (A) Launching of Atlas-Agena; (B) Separation and coasting of second stage Agena; (C) Injection of Agena into orbit; (D) Orientation of satellite into nose-down attitude for operation of IR sensors.

to the inspection satellite to afford adequate resolution in photography (within 30 miles for a 20-ft. object) but that the relative speeds impose severe orientation and equipment problems.

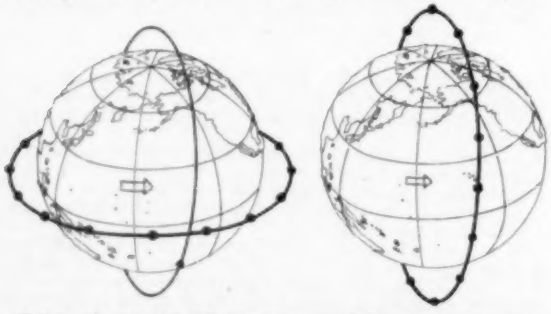
The thought that the Russians have had a large spacecraft (Sputnik IV) orbiting the Earth since May 15, which is beyond our powers to evaluate technically (a photograph has not been released at the time of writing), underlines a problem which could become important if operational space-weapons are sent into orbit.

The only practical solution appears to be to put the inspection satellite into a matching orbit with the "unknown" satellite using vernier rocket engines for the necessary rendezvous manœuvre. But here one must not overlook the fact that closing up behind a satellite by applying another burst of thrust will only result in putting the intercepting vehicle into a higher orbit. Intercepting an orbiting spacecraft —especially if it is itself capable of manœuvre—is likely to present formidable computing problems.

Satellite Decoys

From this, it can be seen that space-operations could become quite complicated in the years ahead and this very confusion could play into the hands of the potential aggressor. The difficulty of identification could be exploited by placing decoys in orbit operating all kinds of "emitters," and it is not inconceivable that orbital devices could be used for drawing attention away from more conventional activity with ground forces and missiles. In fact, the possibilities of spurious devices appear to be limitless once military systems move into space.

Towards the end of the present decade, we can expect to see the number of satellites in orbit increase significantly as scientific satellites and experimental devices are joined by operational satellites of many kinds. Many scientific satellites of the present day will still be orbiting at this time. Vanguard I, the so-called "grapefruit" satellite, has an estimated lifetime of 200 years, while Tiros I is expected to remain in orbit for 50 to 100 years.



Orbits of potential military interest. Left, equatorial orbit for optimum satellite interception. Right, polar orbit for optimum global surveillance, communications relay, weather survey or orbital bombing.

As strings of communications, navigational and meteorological satellites join these vehicles in orbit—and, inevitably, new satellites are launched to replace those which suffer electronic fault—a very large number of vehicles will be involved; some of these will be radiating signals and others will be "dark" satellites, detectable only by optical and radar means.

If maximum security is to be maintained, it is important that tracking and identification systems keep a full inventory of all vehicles in orbit so that, immediately an unscheduled satellite is launched, it can be rapidly identified.

Bombardment Satellites

What, then, are the prospects of satellites as bomb-carriers, as possible competitors of the surface-launched ICBM? First of all, it is clear that the satellite cannot be regarded as a simple extension of the bomber since objects cannot be dropped from a satellite by the mere act of releasing them. To return an object to Earth from a satellite, it must be forcibly ejected by a retro-rocket fired in the opposite direction to the satellite's motion, or at least at a sufficient downward angle to ensure that the object re-enters the atmosphere.

Success has recently been achieved in the Discoverer programme in recovering an instrument capsule from orbit, and this serves to demonstrate the principle. The launching vehicle in this case is the Thor-Agena, comprising a modified Thor IRBM and a second-stage Lockheed Agena rocket employing a Bell Hustler rocket engine of 15,000 lb. s.t.

The Agena second-stage itself goes into orbit and, for re-entry experiments, is fitted with a 300 lb. capsule. In effect, this is a small ballistic nose-cone 27-in. long and 33-in. dia. It contains research instruments and a telemetering transmitter and in one early experiment four black mice were part of the payload.

Ejection procedure is as follows: Once it is established in orbit, the Agena satellite is turned through 180° by means of a gas-jet orientation system so that the nose, which contains the re-entry capsule, is facing aft against the direction of the satellite's motion. With this manœuvre satisfactorily completed, the satellite is tilted into a nose down attitude at 60° to the horizontal.

The capsule's release is timed to occur on the satellite's 16th or 17th orbit somewhere over the North Pole. If this is done correctly, the capsule will be ejected rearwards and downwards by the retro-rocket and will fall into an area 150 miles long and 50 miles wide near Hawaii.

Although 13 launchings have so far been made in the Discoverer programme, only one capsule has been recovered, some remaining in orbit because of electronic failure or faults in the satellite orientation system, while others have been ejected at the wrong time or place and fallen outside the recovery area.

These failures can, of course, be put down to "teething troubles" and before long we can expect to see satellites re-entered from orbit with the same proficiency as ICBM nose-cones are recovered from ballistic flights of several thousand miles. When that time arrives, will it be possible to use satellite re-entry bodies for bombardment purposes against Earth targets?

In many ways, the merit of a simple bombardment weapon of this type is arguable. For one thing, unlike the conventional ballistic missile, it cannot be directed against a particular surface target at any time in a given 24 hours. It could only be cut down from orbit when the target and the satellite were in a certain relationship.

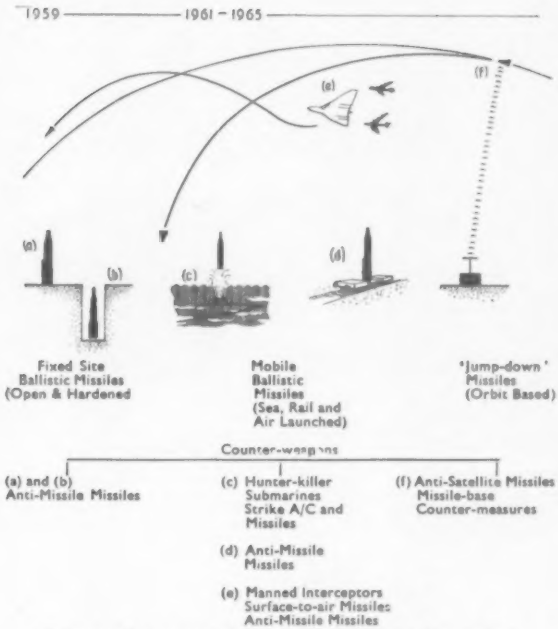
For example, a close-orbit satellite will make one revolution every 90 minutes. If launching is made into a polar orbit, the plane of the orbit will remain "fixed" while the Earth itself revolves. This means that each time the satellite makes one full circuit of the Earth, a fixed point on the equator will have been displaced eastward by $\frac{1}{4}$ of the Earth's circumference.

Indeed, the only orbit in which a satellite can be guaranteed to pass over the same spot on the Earth with each successive rotation is in the plane of the equator, which rather seriously limits its military potential.

To be effective, the "jump-down" bomb would have to be deployed in orbit in large numbers, each vehicle being synchronized with an appropriate surface target against a certain cut-down time. This would require orbital positioning and timing accuracies of a high order.

From the defence point of view, it would be a simple matter to deduce the intended targets and likely cut-down time from the orbital distribution. The use of decoys on random orbits would, however, help to confuse the defence picture.

On balance, it would seem that the elementary ballistic "jump-down" bomb would be very much inferior to conventional ICBMs. Whereas the ICBM can be periodically inspected



Concept of the "mixed" deterrent. Value of the "jump-down" bomb in extending the deterrent capability—as shown here—is questionable.

at its launching site, for example, an orbit-based weapon must remain in a functional condition for days, weeks, or possibly months, without the slightest attention. Without doubt, one of its most vulnerable systems would be that concerned with the satellite's orientation which has the function of ensuring that, when the appropriate command signal is given, the re-entry capsule is fired in the right direction and it falls towards the desired target. Not only must the orientation system be kept in functional order but errors which will accumulate as a result of drift in the gyros must be corrected.

Even if this can be performed without reference to ground stations, it is difficult to see how communication with the satellite could be avoided since, in any case, re-entry must be initiated by a radio-command signal if it is not performed automatically by a timer or some form of astro position-finder.

Thus the problem of initiating re-entry and of arming the nuclear warhead by means which cannot be interfered with from the ground, or from other space-vehicles, is of considerable importance in assessing the merits of the "jump-down" weapon. Indeed, when we think of large numbers of such devices being placed in orbit in a "cold-war" situation, the chances of hostilities breaking out prematurely, or unintentionally, become that much greater because of the possibility of the weapon being set off accidentally. Indeed, it is this very weakness that may act against its use.

Certainly the "jump-down" weapon would be more expensive to produce than the ICBM. It would inevitably require a larger booster, and, since it would probably not be as accurate as a surface-launched missile, more would be required per mission. It seems most unlikely, therefore, that this type of orbital weapon will supersede ballistic missiles launched from underground or mobile sites.

Man in Space

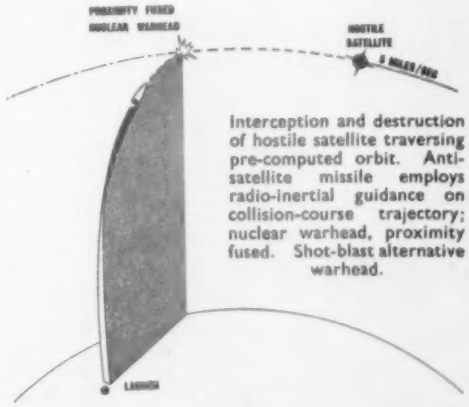
Contributing further to the problem of space-weapons in the post-1965 era will almost certainly be the emergence of man into space. A start in this direction, purely for research purposes, is being made in America with the Mercury capsule which is scheduled to be launched into a low-altitude orbit by means of a modified Atlas ICBM late next year. The capsule is designed to orbit the Earth three times and then be brought out of orbit by braking rockets and recovered by parachute after making a ballistic re-entry.

Following the Mercury project is another man-in-space programme which, from the outset, has been regarded as important from the military point of view. It concerns the development of an orbital boost glider which gains a high proportion of its lift from centrifugal force. This, of course, is the celebrated Dyna-Soar project of the USAF.

Unlike the first man-in-space programme, which involves the launching and recovery of a purely ballistic—non-lifting—capsule, Dyna-Soar will "combine the high speed of a ballistic missile with the controlled and accurate flight of a manned aircraft." It will be boosted by means of a multi-stage rocket to altitudes beyond the Earth's atmosphere and there it should travel at a speed of about 18,000 m.p.h. To re-enter the atmosphere, the pilot will have the use of retro-rockets, gas-jet and aerodynamic controls, and the spacecraft will be able to glide for considerable distances, eventually, it is hoped, to land at Edwards A.F.B. in California. Take-off would probably be from Cape Canaveral using a version of the Saturn booster.

First steps in the programme will be to design and build for flight-testing a glide-vehicle which will bring a man back to a normal landing from sub-orbital speeds. The vehicle itself is expected to have the shape of a narrow delta with wing-tip extensions. A mock-up of the provisional design has already been completed at Boeing's Aerospace Division in Seattle, Washington, but model tests in conjunction with a variant of the Scout booster are to be made before various design features are "frozen."

It has been emphasized repeatedly in America that Dyna-Soar is more than a research programme for manned space-flight and that Strategic Air Command is looking upon the vehicle both as a means of global reconnaissance and orbital bombing. Indeed, the project may hold the key to a wide variety of space operations in the latter half of the present decade, for upon its ability to carry men and supplies into orbit will lie the feasibility of establishing, and maintaining, manned orbital space-stations. Designs have already been published which illustrate the feasibility of launching 35,000-lb. "satellite laboratories" into orbit using the Saturn booster (THE AEROPLANE AND ASTRONAUTICS, Jne. 3, 1960, p. 680).



Interception and destruction of hostile satellite traversing pre-computed orbit. Anti-satellite missile employs radio-inertial guidance on collision-course trajectory; nuclear warhead, proximity fused. Shot-blast alternative warhead.

If such projects become feasible by, say, 1968-70, in conjunction with Dyna-Soar-type spacecraft—which can actually rendezvous with the orbiting space-station with the help of vernier rocket motors—techniques will have been devised for extending identification of unknown satellites to physical inspection. This has, in fact, already been suggested by U.S.A.F. spokesmen as a practical mission for the developed Dyna-Soar and shows how fluid this concept of the military satellite is likely to be, with its rapidly changing capability.

As a reconnaissance vehicle, Dyna-Soar may well have advantages over the fixed-orbit reconnaissance satellite of the Samos type. Apart from being a more difficult target for counter-launched missiles, it would offer greater flexibility in the acquisition of reconnaissance information.

Use of orbital boost-gliders for bombing missions would not impose the same limitations as the purely ballistic "jump-down" bomb described earlier. The ability to glide at hypersonic speed in the upper atmosphere would give the pilot some degree of manœuvre, permitting re-direction by ground command to targets stretching beyond the limits of the orbital plane. The actual weapon carried by the parent vehicle might then take the form of a projectile without inherent propulsion, released on a pre-computed path.

Any merit satellite-bombing may have is not so much concerned with the *method* of delivery as with weapon dispersal and the fact that it introduces *another form* of attack with which a potential enemy would have to deal.

There are many who have argued that there is no requirement for man to enter space—that instruments are better and more efficient for space-research, and that robot equipment can take the place of man in exploring the Solar System. If orbital weapons become a reality, the need for man to enter space to ensure their safety and control will surely be essential.

The only better solution would be to ensure that no weapons go into space at all.

Aviation News in General

BOEING INTERNATIONAL. — A Corporate Office of International Operations has been formed by Boeing under Mr. N. D. Showalter as executive director. The first regional office will be established in Paris and others will be opened as required. Mr. Showalter, a Boeing vice-president, has been with the company since 1928. He was appointed general manager of Boeing's Wichita plant in 1957 and more recently he has been special assistant to Mr. Wellwood E. Beall.

MOSKVICH PRODUCTION. — The Soviet Mi-1 Moskvich four-seat helicopter, a development of the Mi-1, is now in quantity production. The first production Moskvich (CCCP-68131) was recently demonstrated in Moscow.

I.A.L. AT CAIRO. — International Aeradio, Ltd., will be responsible for the system planning and engineering of certain of the facilities for the new Cairo International Airport. The services to be provided by I.A.L. include an HF R/T position, approach control position, telecommunications control position and ground services control position.

PHANTOM EVALUATION.—Climbing out of this McDonnell F4H Phantom 2 at Edwards Flight Test Center is Cdr. P. C. S. Chilton, A.F.C., R.N. Engaged in a brief qualitative evaluation of a pre-production F4H, he flew at Mach 2.1 at 47,000 ft. and tested the aircraft's boundary layer control system.

POLAR TUPOLEVS.—Although the Soviet Air Force is no longer using its Tupolev Tu-4s or Russian-built Boeing B-29s for first-line use, they are continuing to perform a number of non-operational tasks. Two Tu-4s of the Polar Aviation Section of Aeroflot are currently employed on ice reconnaissance and research in the Soviet Arctic. Many flights have been made along the northern coasts of the U.S.S.R., and the heavy Tu-4s have also landed on ice floe airstrips, with members of the Arctic and Antarctic Research Institute on board.

G.E.C. IN MAURITIUS.—Plaisance Airport, Mauritius, is to be equipped with a new airfield lighting system supplied by the General Electric Co. This includes approach, runway, taxi-ing and orbital guidance lights and visual glidepath indicators. Mauritius is an important stage in the Indian Ocean and is used by S.A.A. and Qantas, on their service between South Africa and Australia, and by Air France.

COMPANY SALE. — Bell Aircraft Co.'s sale of its defence business to Textron, Inc., was recently approved by stockholders. Textron will pay $22 million for the business, which it will call Bell Aerospace Corp. Bell Aircraft will be renamed Bell Intercontinental Corp. and will retain land and buildings used by the defence group, but rent them to Bell Aerospace for $1.3 million under a 10-year lease.

EAST GERMAN ORDER.—Tyres, wheels and brakes for the V.E.B. Flugzeugwerke 152 jet transport are to be supplied by Dunlop's Aviation Division.

INDIA BUYS S-62s.—According to an American report, the Indian Government has ordered two Sikorsky S-62 helicopters. The type may be chosen for production in India to meet Air Force requirements for helicopters.

IL-14 FOR LUMUMBA.—An Ilyushin Il-14 piston-engine transport has been presented to Mr. Lumumba, Prime Minister of the Congo Republic, by Russia. Many such gifts have been made to African and Asian leaders in the past few years.

MODIFIED PLATFORM.—A ground-to-air view of the modified Hiller VZ-1E "Flying Platform." It has helicopter-type controls and the pilot is now seated.

LARGE HYDROGEN MOTOR.—Aerojet-General have announced the successful test-firing of a lox-hydrogen rocket engine of 200,000 lb. s.t. Prototype engine has all the major components required in an operational power unit, including fuel and oxidant pumps.

SPACE FACTORY.—A unique feature of the Canadian Topside-Sounder satellite is that the 64 ft. span aerials will be actually manufactured on board by passing spring-steel tapes through dies to form pipes. The Americans are to launch the satellite—built by de Havilland Aircraft of Canada—using a three-stage Thor-Delta.

PROJECT APOLLO.—The National Aeronautics and Space Administration have announced plans to develop an advanced space-vehicle called Project Apollo to carry three men into orbit around the Moon. Contracts to develop the vehicle will probably be awarded in fiscal year 1962. Test-versions of Apollo may be in orbit around the Earth by 1966, say NASA officials.

Commercial Aviation Affairs

U.S.-SOVIET CO-OPERATION. — A U.S. civil aviation delegation, headed by Mr. E. R. Quesada, the F.A.A. Administrator, is to make a three-week visit to the Soviet Union between Sept. 19 and Oct. 7. This will follow a visit by an 11-man U.S.S.R. delegation to Washington this month for the study of airport and A.T.C. centres in the U.S.A.

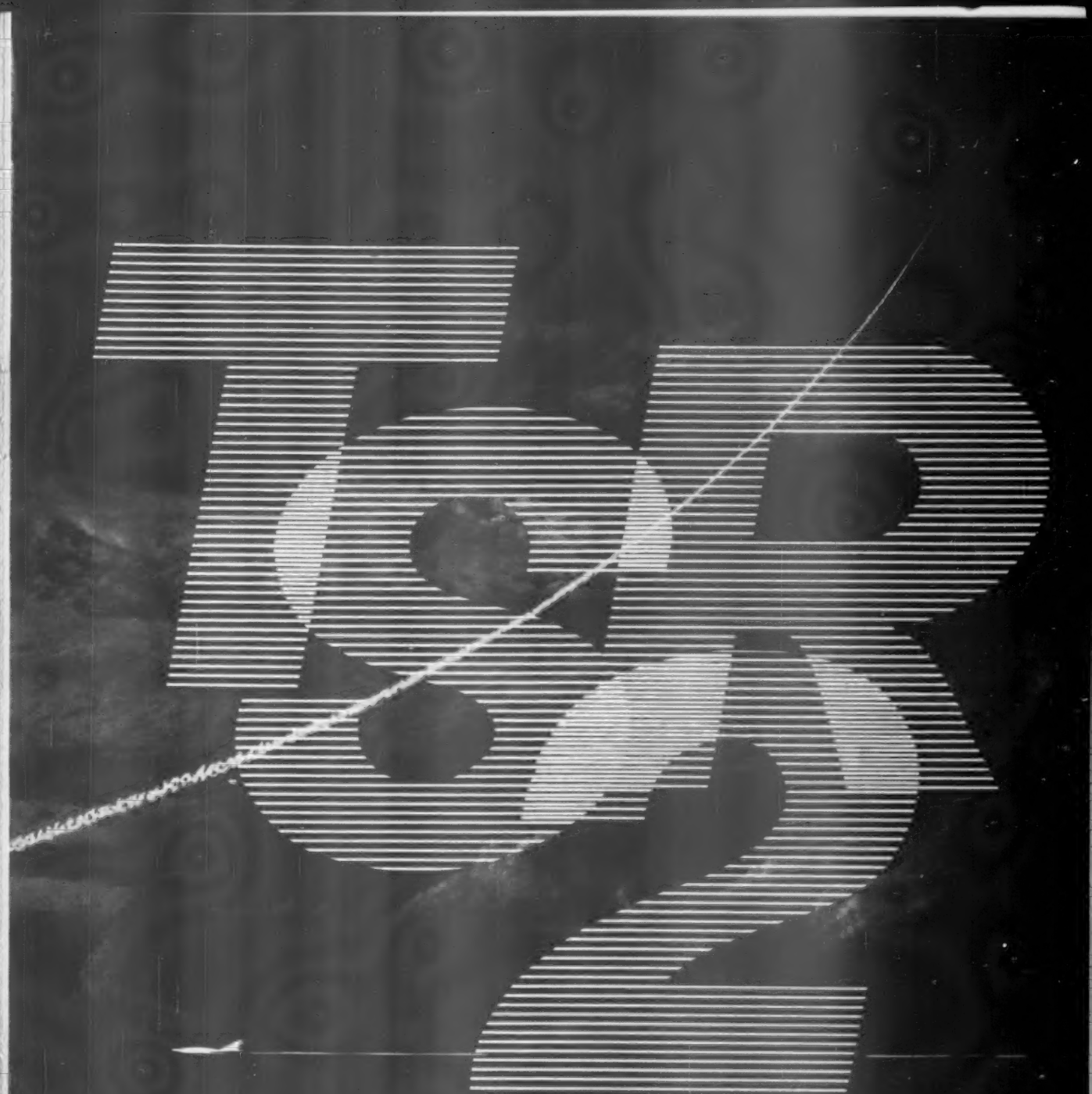
FREQUENCY CHANGE.—On Jly. 1, 1961, radio frequencies for aircraft in upper air space (above 20,000-25,000 ft.) in the European-Mediterranean Region will be reassigned using 50 kc/s. channel spacing within the band 118-132 Mc/s. Lower air space aircraft will use channels with 100 kc/s. spacing in the same Mc/s. band until Jan. 1, 1964, when 50 kc/s. spacing will be adopted for all altitudes.

INSURANCE LIMIT.—The F.A.A. has reduced from $425,000 to $165,000 the maximum flight insurance which may be purchased at Washington airport, in order to reduce the risk of sabotage. At least five cases of airliner sabotage since 1946 have been associated with insurance on the lives of passengers.

FLIGHT RECORDERS REQUIRED. —Nov. 1 has been fixed by the F.A.A. as the date by which all U.S.-registered turbine-powered transport aircraft over 12,500 lb. gross weight must be fitted with flight recorders. Up to six months' extension will be allowed to meet airlines' maintenance and installation programmes.

RADIO ALTIMETER CHANGE.—From May 1, 1961, the frequency band 420-460 Mc/s. will no longer be allocated to aeronautical radionavigation, but will be reallotted to fixed, mobile, amateur and radiolocation services. Whilst the use of radio altimeters in this frequency band may still be acceptable over sea, airlines are advised to use radio altimeters in the 1,600-1,660 and 4,200-4,400 Mc/s. bands in future.

(*More News on page 227*)



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(*Continued from page 226*)

CAPITAL MERGER.—The Boards of United Airlines and Capital Airlines, meeting independently on Aug. 11, approved the plans for a merger between the two companies (our issues for Aug. 5 and Aug. 12). Shareholders of both companies will meet on Oct. 14 to vote on the merger. C.A.B. approval has been formally requested, it being a condition of the merger that the C.A.B. take action by Feb. 1, 1961. Another condition is that the present operating certificates of Capital remain unchanged.

ATLANTIC PROGRESS. — Aerlinte Eireann, the Aer Lingus transatlantic division which is to put Boeing 707-048s into service in December, has shown good progress on its preliminary Atlantic operations. These are at present operated with L-1049Hs leased from Seaboard and Western. In the year ended Mar. 31, 1960, 23,278 passengers were carried—or 57% more than in the first year of Atlantic operation.

CAMBRIAN TO CORK.—When the new airport at Cork is opened—probably in mid-1961—Cambrian Airways will include this important southern Irish centre in its network. U.K. approval has been obtained for the operation of services to and from London, Bristol, Cardiff and Swansea. The extension of the Cambrian network to London is an important development for the company.

AIR-UNION 1962?—Lufthansa has estimated that a common Air-Union flight plan for Europe cannot be expected to be in operation before 1962 at the earliest.

ROME AIRPORT OPENS.—The new international Leonardi da Vinci Airport at Fiumicino will be formally opened on Aug. 20 by the Italian President, Sig. Giovanni Gronchi. Initially, it will be used only for charter flights; the airlines are expected to transfer from Ciampino to Fiumicino later in the year (see our issue for Jan. 29).

B.O.A.C. TO RIO.—Following the completion of runway extensions at Galeao Airport, Rio de Janeiro, this is now included as a stop on B.O.A.C.'s Comet services on the London-Santiago run.

M.E.A. COMETS.—The first of three groups of M.E.A. pilots, making 23 in all, to train on the Comet in U.K. this year arrived on Aug. 8. Scheduled service with the Comet 4Cs will begin in January, with daily flights from Beirut to London serving, variously, Vienna, Frankfurt, Athens, Geneva and Rome; and two flights a week to Rome, Madrid and Lisbon. In due course, the Comets will serve M.E.A.'s Eastern routes to Dhahran, Karachi, Kuwait, Bahrein, Dohar, Jeddah, Aden, Baghdad and Tehran.

SEVEN BELLS.—More accurately, seven records were recently set up by this Bell HU-1 Iroquois helicopter, which is powered by a General Electric T58 turbine, and is seen here on its 100-km. speed run at 142.2 m.p.h.

LOSS ON ELECTRAS.—Total cost of the Electra investigation has been reported by Lockheed to be $1,241,000. The company is also absorbing modification costs of $11,441,000. The balance sheet for the first half of 1960 also includes an item of $11,774,000 as loss on 21 Electras delivered and 27 still on order. Total loss for the six months, including supersonic transport JetStar and Super Hercules development costs, amounts to over $67 million to be set against earnings of about $12 million.

IATA OFFICE. — A new technical liaison office for the Far East has been opened at Bangkok (P.O. Box 1196), Thailand, by IATA. The office will co-ordinate technical activities in the south-east Asia and Pacific regions and is temporarily directed by Mr. Hedley O. Wiles of the IATA European technical office in London.

U.S.-ITALY AGREEMENT. — An amended air transport agreement between Italy and the U.S.A. permits Alitalia to operate to Chicago. In exchange, a U.S. airline may serve Turin.

QANTAS RECORD.—In the first full year of jet operations, Qantas carried 78,141 passengers a total of 368 million passenger-miles in its fleet of seven Boeing 707s, which flew for 16,300 hr. Average daily utilization worked out at just below 7 hr. per aircraft over the whole fleet.

FREIGHT SERVICE.—Tradair, Ltd., has been granted approval for an all-freight service between Southend and Zurich until March 1967.

News About People

CANADAIR SALES.—Mr. T. Gilbert Dunkin has been appointed assistant manager, sales engineering, by Canadair, Ltd. He had been with Avro Aircraft, Ltd., since 1946, where his final task was to survey aircraft market prospects. During the War he served with the British Air Commission in the U.S.A.

CYPRUS CHAIRMAN. — Mr. G. Eliades, Under Secretary of the Cyprus Ministry of Commerce and Industry, has been appointed chairman of Cyprus Airways in succession to Sir Colin Raeburn. The Cyprus Government holds 56% of Cyprus Airways shares; B.E.A., which operates the services, holds 22.7%.

THREE DIAMONDS.—Philip Wills, chairman of the B.G.A., made a flight of 332 miles in a Slingsby Skylark 3 on Aug. 4 whilst on holiday in Texas. For this feat he has been awarded the three diamonds to his International Gold C badge, thus becoming the third British holder of the award.

SERVICE MANAGER.—Mr. Harold Stringer, service manager of Bristol Siddeley Engines. The company's aero service departments have recently been centralized at Bristol.

OLIVEAU RETURNS.—Mr. M. E. Oliveau, who was responsible for the organization of Douglas Aircraft's European division in 1946, is to return to Geneva as head of the division shortly, following the resignation of Mr. Heinemann.

WITH ROLLS-ROYCE. — Mr. Hugh B. Cundall, development engineer with Hunting-Clan Air Transport until its merger with Airwork, is now with the sales and service organization of Rolls-Royce.

FULLER DIRECTOR.—Mr. D. Malcolm Brown, the general manager of the former West African Airways Corporation, has been appointed managing director of A. H. Fuller, Ltd., by George Westons Holdings, Ltd.

Manpowered Flight Achieved in 1936?

New facts about an Italian pedal-driven machine have been discovered by B. S. SHENSTONE, F.R.Ae.S.

Fig. 1. The Bossi-Bonomi machine in flight.

THE Bossi-Bonomi manpowered aircraft of 1936, although imperfect and too heavy (like any other aircraft), was probably the most successful manpowered aircraft ever built.

Too little information seems to be available about it, which may be the result of Fascist politics those many years ago. The trouble wa that although Enea Bossi was once an Italian (2nd Italian pilot's licence) who had designed aircraft for Guidoni during World War I, he was an American in the 1930s and still is. As he told me recently in New York, he found himself back in Europe in the '30s working for Budd, and took the opportunity to realize his ideas with the collaboration of his friend, the late Vittorio Bonomi, a well-known industrialist and sailplane manufacturer. The basic design was Bossi's, but it was detailed by Bonomi's people.

An official prize had been offered in Italy for a successful manpowered flight, but the Bossi-Bonomi aircraft was refused entry on the excuse that Bossi was no longer Italian and also probably because Bonomi was anti-Fascist. It was, therefore, not possible to obtain officially observed flights and Bonomi finally arranged a demonstration before the Press.

Mr. Bossi states that not only did the aircraft fly successfully at this demonstration, but the pilot, Emilio Casco, took the machine off under his own power without storage of energy. This remains unique and deserves wide publicity.

Let us not think that this demonstration was just a flash in the pan. The aircraft had flown often before and much development work had been done. Eighty flights had been made and Bossi states that Casco had taken off without help about 30 times. Admittedly the take-off was touch and go, although Casco was the strongest pilot that could be found. His leg power output for a short (unspecified) period was about 1½ h.p. or 20% greater than Hofman who flew the Haessler-Villinger aircraft. Take-off speeds were of the order of 20-23 m.p.h. and cruise was 25 to 30 m.p.h. Take-off runs on concrete were between 150 and 200 yards and at about 100 yards the aircraft began to lift. It was found to be essential to keep the aircraft at low incidence during the run, thus permitting the aircraft to "fly off" rather than be pulled off. Any attempt at pulling off was sure to fail. Even so, the take-off was marginal, some days being impossible and on others fairly easy.

No information is available on the distance flown after unassisted take-offs, but one may assume that the great exertion needed for take-off would make a long flight impossible. The cruising power required was 0.89 h.p. and it was estimated that Casco could do this for about 1½ minutes. Some of the actual performances with assisted take-offs up to about 25 ft. altitude before release were as follows:

DISTANCE	TIME	SPEED
2,950 ft. 900 metres	71 seconds	28.3 m.p.h. 46 km/hr.
2,450 ft. 750 metres	53 seconds	31.5 m.p.h. 51 km/hr.
1,640 ft. 500 metres	47 seconds	24 m.p.h. 38 km/hr.

In one long flight of about 1 km., which took place at the Cinisello airfield (where the Breda Aircraft works were situated) on Dec. 23, 1936, two right-angled turns were made and a third partially completed. This flight also was shock-cord launched.

So much for what the Bossi-Bonomi "Pedaliante" accomplished, but what was it like and why did it do so well?

It was a high-wing, single-seat aeroplane of fairly high aspect ratio (13.4) and low wing loading (about 1.6 lb./sq. ft.). It was of wooden construction, and considerable detail may be seen in Fig. 2 (skeleton structure). The fuselage consisted of a triangular frame linking wing, tail and pilot, and was faired in by a light fabric-covered structure. The pilot used only his legs, which worked on bicycle pedals (Fig. 3), which drove a sprocket-and-chain system to:—

(a) The two leading-edge tractor propellers, rotating in opposite directions to counteract torque, through shafts and bevel gears.
(b) The single undercarriage wheel through a double gearing-up, corresponding to a speed at the wheel of 25 m.p.h. for full-speed pedalling at 120 r.p.m. or 15 m.p.h. at 72 r.p.m.

There was no clutch arrangement, so that both propellers and undercarriage wheel were worked simultaneously, the propellers taking the load as the wing started to lift.

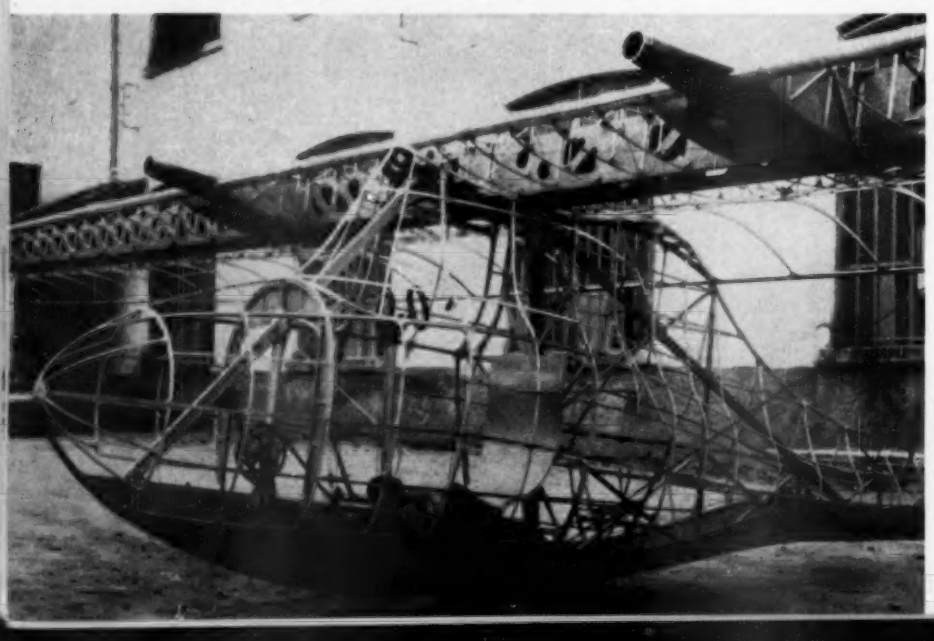


Fig. 2 Skeleton structure.

Bossi confirms the conclusion reached by others that there is no chance for an unaided take-off without wheel drive because at low forward speeds propellers are very inefficient and operating them alone would tire a man well before take-off speed was reached.

The control of the Bossi-Bonomi was normal for elevator (stick forward and back). The wheel was rotated to left and right on a horizontal axis for lateral control and swung on a vertical axis for directional control. Rudder and elevators were normal, but lateral control was by spoilers. When not in use, they lay flat on the wing, and when used were pushed up against the airflow around forward hinges. They were of saw-tooth form. They may have been not quite satisfactory as a photograph was published in 1937 showing another form of lateral control, ailerons supported above the wing in a

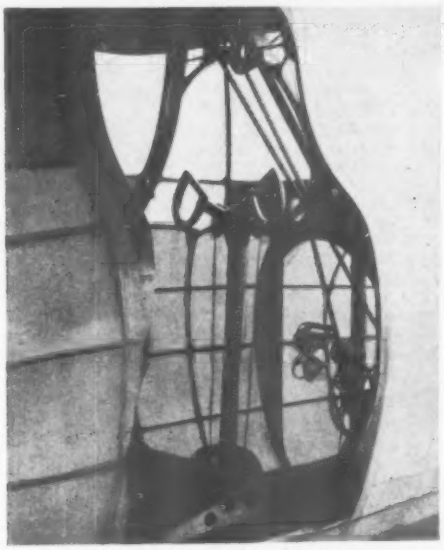


Fig. 3. Interior of cockpit.

form not unlike those of the early Northrop Gamma. Ordinary ailerons could not be used because of the special wing section, NACA 0012-F1, which is the normal symmetrical section with a flap-like aft extension giving the effect of an aft camber and is so thin and flexible that normal ailerons are impracticable.

Although Bossi was an expert on propeller design he found it necessary to try several different propellers and he states that finally he wanted one larger that would clear the fuselage. He says that the two most important factors in the design of manpowered aircraft are propeller design and low structure weight.

Bossi-Bonomi propellers were laminated with a middle strong wood backbone which formed the very small hub, the other layers being balsa wood. The tips were weighted to provide some flywheel effect because of the wide torque variations of the one-man pedal drive. Bossi's final injunction on propellers was: "big and slow-revving and contra-rotating." (Fig. 5.)

The structure weight is most important in Bossi's opinion.

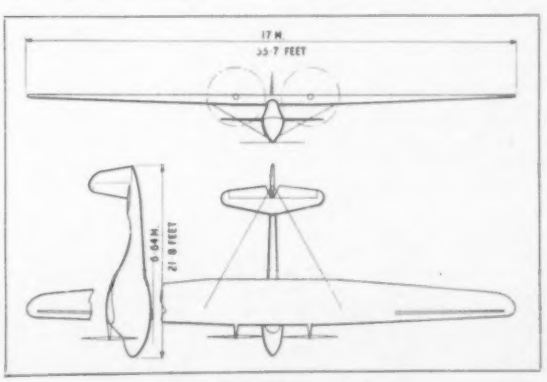


Fig. 4. General arrangement.

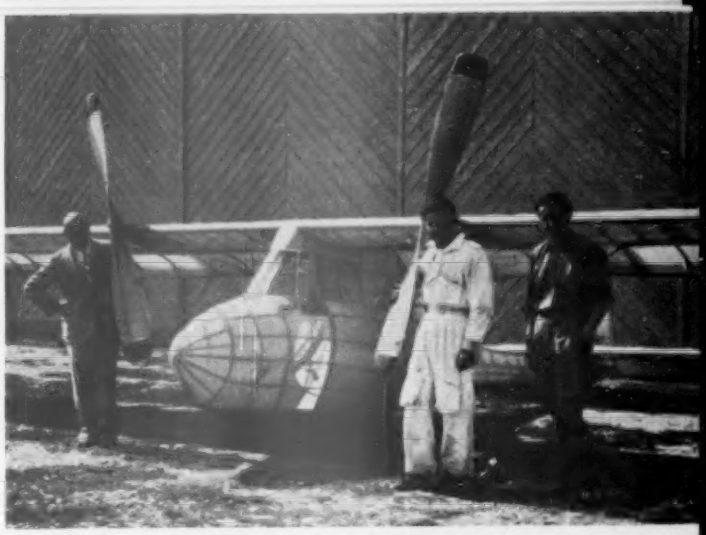


Fig. 5. Propeller installation.

The actual weights of the Bossi-Bonomi aircraft vary somewhat with the source of data, but Bossi states that it was 66 lb. (30 kg.) overweight. Since the empty weight is quoted at 198 lb. (90 kg.) and 214 lb. (97.3 kg.), this does seem a large percentage. Bossi says that considerable weight was lost in the drive, particularly in the shaftings protruding from the wing leading edge and their fairings. Also considerable weight was wasted as a result of arguments with the airworthiness authorities. At one time there were wing struts, later replaced by wires.

No matter how good a basic design may be, it needs development. The Bossi-Bonomi was no exception. Reference has been made to propellers and ailerons. The first flights were made with a three-wheeled undercarriage, formed by a normal two-main-wheel undercarriage and the driven wheel to give ground stability. As experience was gained, the extra wheels were discarded. Initial taxi-ing trials were done without the outer wings in place. Considerable practice was needed for the pilot to get used to the pedalling and the unusual control handling. After a few miles of wingless taxi-ing, non-pedalling towed flights were made and so on until Casco grew confident enough to control and pedal in flight.

Silva, in writing about the Bossi-Bonomi in 1938, describes the efforts made to develop an energy accumulator to assist the difficult job of otherwise unaided take-offs. One accumulator consisted of a dural tube containing a number of rubber strands fastened at one end to a piston sliding in the tube and at the other end to the base of the tube itself. It was installed in the fuselage and steel cables were run over a pulley network to increase the useful length and the cable was then wrapped around a drum fastened to the same shaft as the pedals, and the whole system tensioned by the pilot before take-off. Many difficulties were encountered, with hysteresis, rubber-strand connections, space availability and other things, and the scheme had to be abandoned. This experience was paralleled in the Haessler-Villinger aircraft.

This note ends with two questions, the answers to which would be most useful for anyone's records:

(1) Does the Bossi-Bonomi aircraft still exist, possibly in a museum in Italy?

(2) Where can one find the signed record of the demonstration to the Press when Casco took off under his own power unaided? Would it be among the papers of the late Vittorio Bonomi?

DATA ON THE BOSSI-BONOMI PEDALIANTE

Span	55.7 ft.	17 m.
Wing Area	226 sq. ft.	21 sq. m.
Aspect Ratio	13.4	13.4
Weights*		
Wing	99 lb.	45 kg.
Fuselage and Tail	79.2 lb.	36 kg.
Equipment	35.8 lb.	16.3 kg.
Empty Weight	214 lb.	97.3 kg.
Crew	143 lb.	65 kg.
ALL-UP-WEIGHT	357 lb.	162.3 kg.
Ultimate Load Factor	4	
Wing Section	NACA 0012-F1	
Best L/D	27.5	
Best Sinking Speed	1.05 f.p.s.	0.32 m./s.
Best Flying Speed	25 m.p.h.	40 km./hr.
Wing Loading	1.58 lb./sq.ft.	7.7 kg./sq. m.
Span² Loading	0.114 lb./sq.ft.	0.56 kg./sq.m.
Pedal Speed	1 to 2 r.p.s.	
Propeller Speed	150 to 200 r.p.m.	
Propeller Diameter (Range of sizes tested)	7.4 ft.	2.25 m.
	6.3 ft.	1.87 m.
Minimum Power Required	0.89 h.p.	0.99 c.v.

* Empty Weight also given as 198 lb. (90 kg.) and Crew Weight given as 172 lb. (78 kg.).

Personal Flying

UPROAR has been caused in personal flying circles in the United States by the F.A.A. decision to outlaw the family doctor for medical examinations for student and private pilots' licences. Such medicals can now be performed only by designated doctors, who have taken courses of training in aviation medicine, and "maintain a detailed knowledge and understanding of the subject matter of a manual of instructions, published standards and periodic directives issued by the Agency."

On this basis, there are currently some 2,000 designated medical examiners in the U.S. to cope with 380,000 actively certificated civil pilots. Each doctor will therefore have to cope with an average of 190 pilots, but obviously some will have a great many more, while many pilots will find it difficult to find a designated examiner in their vicinity.

• • •

In Canada, the two-seat Fleet Canuck club trainer and tourer is in limited production by Leavens Bros., Ltd. In its present form, the high-wing Canuck has a Continental C-90 engine driving a Sensenich metal airscrew, and is of robust steel tube and fabric-covered construction.

More than 200 Canucks were originally built by Fleet Aircraft, Ltd., from 1946 onward, and many are still in service with Canadian flying clubs.

• • •

Customs facilities are now available at Shoreham Airport during weekdays and Sundays from 09.00-10.00, 14.30-15.30, and 18.00-20.00 hr. On Saturdays, the times are from 09.00-20.00 hr. but if clearance is required other than at the above times, notice must be given by 17.00 hr. on the previous day for clearance before 12.00 hr. and before midday for clearance the same afternoon.

For clearance on Sunday, notice must be given by 12.00 hr. that day; air traffic control at Shoreham 2303 or by tie line can make the necessary contact. A small charge is made for Customs attendance.

EMERALD.—The first imported Scintex CP.310C Emeraude, G-ARDD, recently appeared on the British Register following its purchase by Mr. R. D. Dickson.

• • •

Did you know that California has more than six times as many active civil aircraft registered within its area than the whole of the United Kingdom? The latest available figures show 8,761 for California, and 1,387 active aircraft on the British Register.

The F.A.A. have reported that civil aircraft in active use in the United States now total more than 70,000 for the first time, and all but 2,000 of these are employed by general aviation, i.e., by non-scheduled, private, executive and club operators. Over 6,000 airports are available within the U.S., about half being for general use.

Gliding Notes

by Dr. A. E. Slater

YORKSHIRE Gliding Club's part in National Gliding Week (Jly. 24-Aug. 1) was to provide the nearest thing to a one-class contest yet held in this country. There were three 12-metre Swallows and one Swift, which is a Swallow with 2-metres more wing span.

To make a contest day, 25% of the competitors (meaning one Swallow) had to exceed 10 miles, and as the Swallow from Cambridge, flown alternatively by J. P. Griffiths and Stuart Waller, managed to do this on six days, it won the contest easily with 600 points, two at least of the flights being done without thermals by hill-soaring along the Clevelands. Thus, on the first day Waller soared past the Newcastle Club to Ingleby Greenhow, his goal.

The task on my day of arrival was Sherburn-in-Elmet and return, 61 miles. Griffiths took the Cambridge Swallow 20 miles and Henry Doktor the Yorkshire Swallow 15 miles.

So the task-setter, Chris Riddell, set out with the met. man, Paul Emery, in the T-21 in the hope of proving the Task possible. As it wasn't, owing to clamp in that direction, they turned down wind and made 33 miles to Scarborough.

Next day, with thermals too broken to use, a 25-mile race northwards to Redcar was set, in the hope that pilots would get enough height soaring along the Clevelands to make a down-wind dash to the goal. But there wasn't enough slope lift.

All the competitors scored before the finish: in addition to Cambridge's 600 points, the Yorkshire Swallow's total was 87.4, the Swift's 50.25 by its owner, A. D. Hill of Yorkshire, and the Crown Agent's Club Swallow 38.7 by Godfrey Harwood.

• • •

A DISUSED airfield at Edgehill, at the N.E. end of the Cotswolds, is the Coventry Club's subsidiary site, and 13 sailplanes flew from there during National Gliding Week. As at the Newcastle Club's site, the landowner is fortunately keen on gliding and has a son who glides. In fact, on the last day but one, Jly. 31, John Greenaway, son of the farmer who owns the site, not only completed the task, a race to Cranwell, but continued on to Usworth, near Newcastle, to make his 300-km. distance leg for Gold "C" and earn a Diamond for a goal flight.

Among the 15 original entries, one was scratched, one suffered a road accident on the way there, and one was pranged on the first day, leaving 12 to carry on. Lionel Redshaw, the eventual winner, has been something of a dark horse. One of the founders of the Furness Club 29 years ago, he bought an Olympia after the War, when that club became defunct, and flew it around the Lake District with only his wife to launch him. Now, with a Skylark 3F, and a whole family to help, he has been increasing his skill in secret, to the surprise of his competitors.

No one got away from Edgehill on Jly. 25, the day when flights were being made from Dunstable to the East Anglian coast and from Odiham to Deal. On Jly. 26, a difficult day for both Dunstable and Yorkshire, Redshaw far outflew everyone with 110 miles from Edgehill to beyond Stowmarket.

• • •

A GOOD day for distance at the London Club's National Gliding Week at Dunstable was Jly. 27, with nine pilots landing on Caistor beach, 111 miles away. Unfortunately for eight of them, Mick Kaye took a second pilot in his Eagle and so earned a 10% bonus, with the result that the others scored only 90.9 points. Yarmouth was the goal that day for competitors at Edgehill, but only Bernard Davey (Imp. Coll.) reached it.

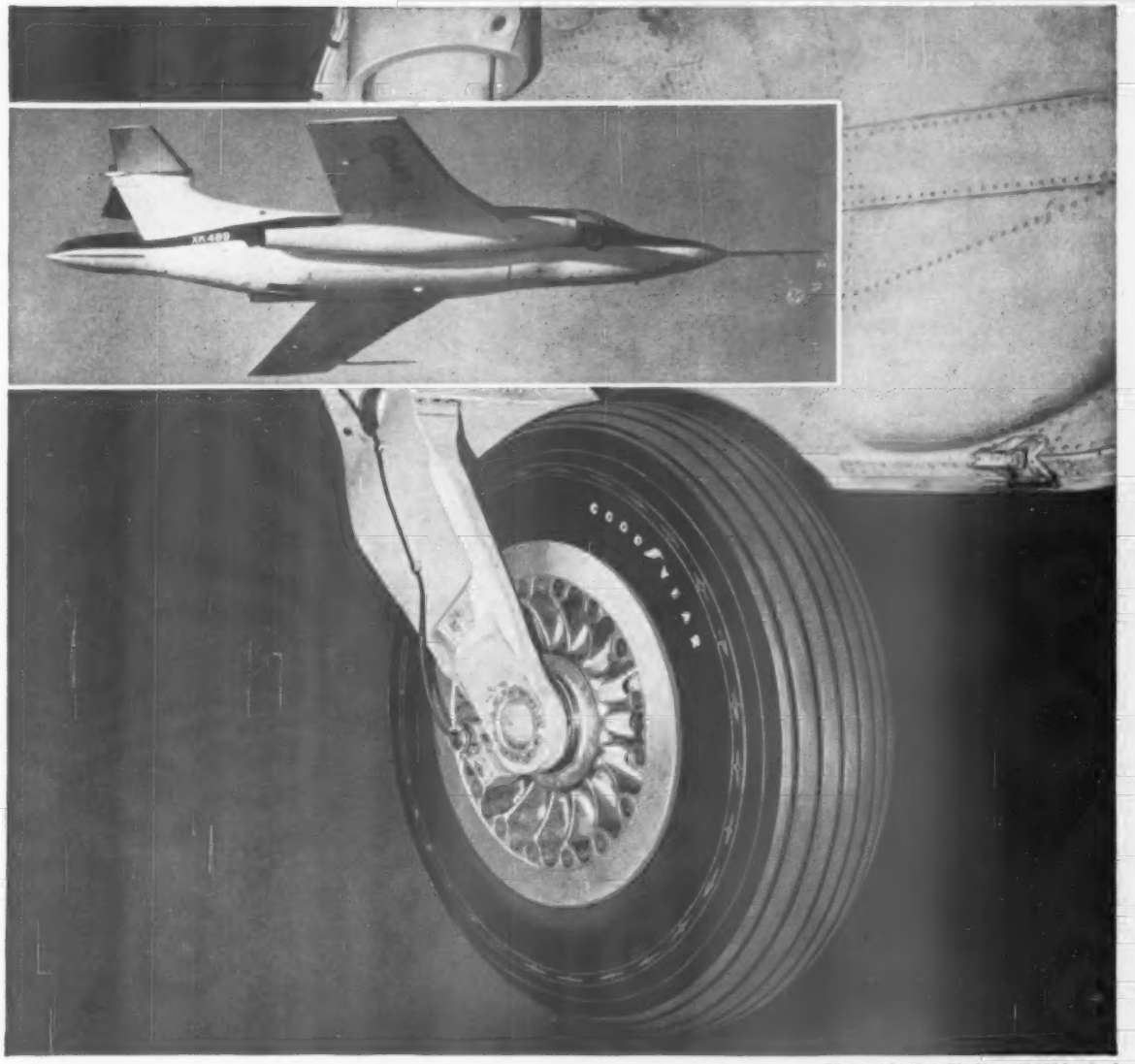
On the next good day, Jly. 29, 12 pilots from Dunstable completed an 87-mile race to Swanton Morley, Peter Scott winning it at 55.9 m.p.h. From Edgehill Redshaw made 115 miles down wind to Mablethorpe, but he was very much off the set course through Tollerton, Nottingham, and was marked on only 63 miles. Nevertheless, he still beat his most serious rival, Davey, who made 61 miles on course. The best flight from Odiham was to Yarmouth by David Ince.

On Jly. 31, Dunstable had a race to Peterborough and return, 102 miles in all. The return was almost against the wind, with cu-nims spreading out over the route to baulk the unlucky ones, some of whom were forced to make enormous detours in a vain attempt to get home—in fact, Godfrey Lee finished up at Market Harborough and Roger Mann, deviating the other way, finished at Luton after seven hours flying. Four completed the course: Peter Scott took 2 hr. 47 min. and won at 38.9 m.p.h.; George Burton averaged 35.1, Geoffrey Stephenson 34 and Mick Kaye 28.2 m.p.h.

The final day, Aug. 1, brought that rare situation, strong instability in a south wind, and several Dunstable pilots gave Lossiemouth, only 65 miles short of John O'Groat's, as their goal—not because they expected to get there, but because it would be a record if they did.

Roger Mann went just over the Durham border with 200 miles, and Peter Scott ran him close with a mile less. Others to reach Yorkshire were "Chuck" Bentson (of U.S.A.), George Burton, David Carrow in a new Mucha Standart (now being sold to Finland), Charles Ellis, Dan Smith and Mike Riddell.

Met. briefing was done by Charles Jarvis at Edgehill and F. E. Dinsdale at Dunstable.



Photographs show Blackburn NA39 low-level strike aircraft, and close-up of wheel assembly. By courtesy of Blackburn Aircraft Limited.

Blackburn NA39's will come in on Goodyear

When they land, production Blackburn NA39 aircraft will be depending on tyres, wheels, brakes and anti-skid equipment by Goodyear—proved equipment that's without peer for efficiency, reliability and economy in weight.

Brakes — maximum non-fading reserve of braking power. Light and strong. Rapid cooling. Easy to maintain.

Anti-skid equipment — prevents wheel-locking and protects braking system.

Wheels — divided at centre to facilitate tyre-mounting and withstand strain of high landing speeds.

Tyres — Ribbed Tread design with tough, high-tensile cord carcass.

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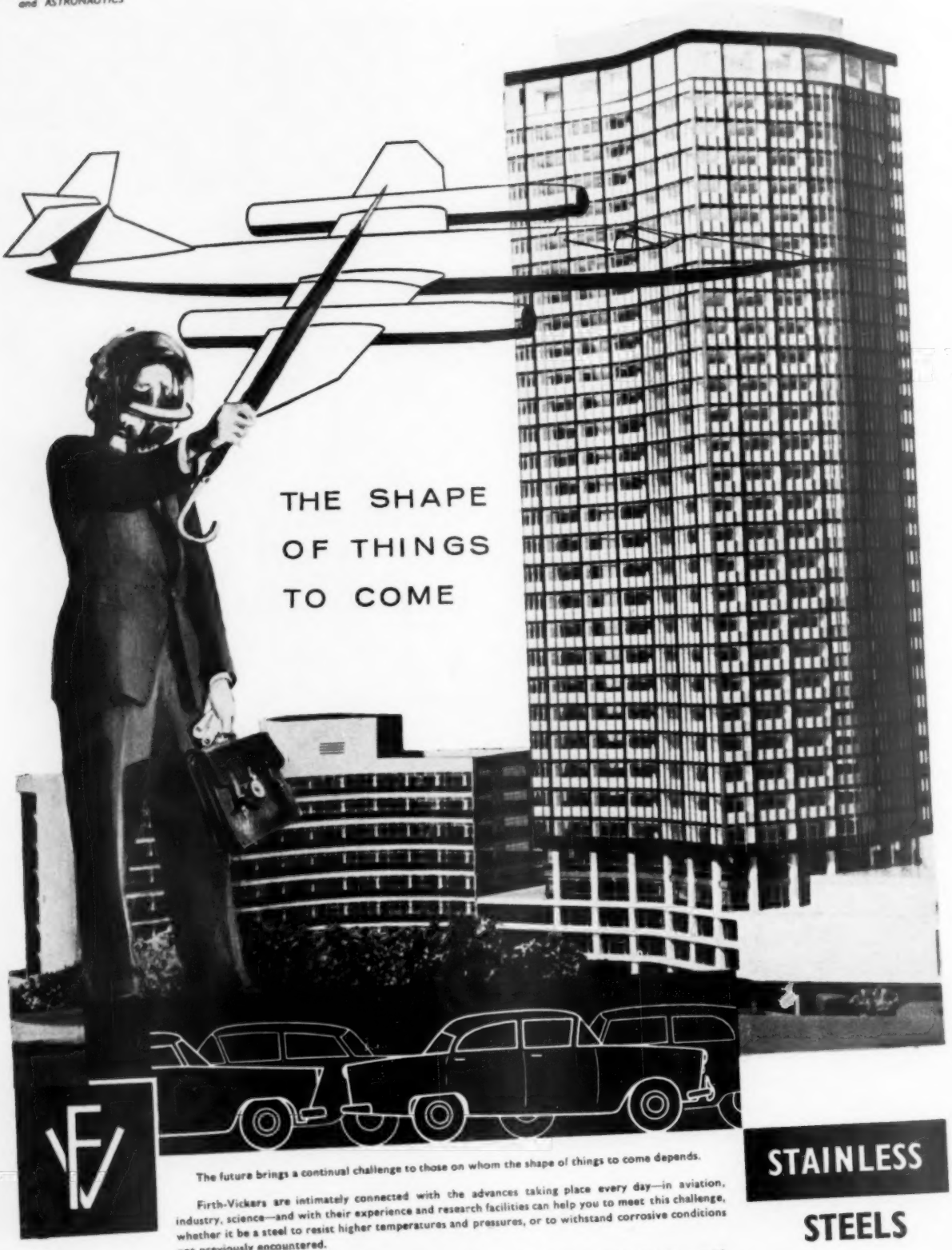

The future brings a continual challenge to those on whom the shape of things to come depends.

Firth-Vickers are intimately connected with the advances taking place every day—in aviation, industry, science—and with their experience and research facilities can help you to meet this challenge, whether it be a steel to resist higher temperatures and pressures, or to withstand corrosive conditions not previously encountered.

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Correspondence

Air Traffic Control and R/T

MAY I please be allowed to cast my humble vote against two recent most unwelcome innovations.

One is the new system of flying at "flight levels." This might be convenient for fast long-distance aircraft which may not wish to bother with local altimeter setting regions as they fly along, but what about short-haul low-level traffic? It is a considerable nuisance to have to reset one's altimeter no less than six times on each short flight (QFE, QNH, 1013 mb., and then back again); and there is the ever-present danger of a pilot forgetting to change from 1013 to the proper QNH on the way down.

It is respectfully suggested that the transition altitude be raised to 10,000 ft., a nice round figure. Up there it would conveniently separate pressurized from non-pressurized aircraft, it would be out of the way of aerodrome approach and holding patterns, and also the possible loss of airspace at that height is not as bad as lower down. Such an arrangement would probably satisfy both the long-range aircraft which would be above 10,000 ft. and the short-haul ones below 10,000 ft.

The other recent annoyance is the arbitrary allocation of heights on airways instead of a universal application of the Quadrantal Height Rules. This might have worked had all traffic been on airways, but in this country there is a lot of scheduled civil and military traffic off airways which goes by the quadrantal rules. The position is now like having two different highway codes on two adjoining roads. The chaos at the junctions can be imagined, and does in fact occur at such places as Ottringham and Carnane (I.o.M.) beacons.

The position regarding aircraft crossing airways is now no longer clear at all. For example, Advisory Route 158 crosses Amber 1 at Dean Cross. If an aircraft on the ADR has radio failure before crossing the airway, he can no longer do so safely at his proper quadrantal height; he has to go up 500 ft. or down 500 ft., but which? This new situation is rather upsetting. It is recognized that there is no complete liaison between civil and military traffic, but one felt that the quadrantal system would take care of that up to a point. Unfortunately, now, even that small consolation has gone.

Another consequence of those two new systems is that they have greatly increased the amount of talking on the radio. It is becoming such a burden to listen out on the R/T that it takes more effort than flying the aeroplane. We should seriously ask ourselves whether by continuously complicating things we are really progressing or rather going back. There should be as few artificial terms and concepts as possible, and if some new methods seem more trouble than they are worth, they should be discarded before they become useless ingrained habits.

Blackpool, Lancs. "AIRLINE CAPTAIN."

Aero-electronics—Some Further Home-truths

IN his letter (issue of Jly. 29), Mr. A. L. Segall, technical vice-chairman, International Airline Navigators Council, questioned the competence of a pilot to comment on long-range navaid requirements (my article, Jly. 15).

Apart from the fact that this article was an unsolicited commission by the magazine concerned, I should like Mr. Segall to know that this year's Istanbul IFALPA conference specifically included an agenda item on long-range navaid requirements. This was submitted as a working paper by BALPA (based on its own ratified policy on the subject) and after sub-committee consideration was presented to plenary session in the form of a resolution for study by the 80-odd pilots and the invited I.A.N.C. observer at the conference. Similarly, other "non-pilot" topics such as the competency of A.T.C. personnel, implementation of Victor Airways Systems, and the like were considered to be within the scope of a gathering of international pilots and equally assessed.

As a navigator Mr. Segall is entitled to his views, and I personally respect his years of experience, but it would be narrow-minded and churlish of him to deny to pilots their basic democratic rights to hold and to express views themselves. Navigation, in all today's broad aspects is not a closed shop.

To reply to the remaining points of his letter:—

1. I am certainly not blind to the physical presence of a qualified navigator (often these days, I might add, a pilot holding the necessary licence) in the cockpit on those sectors where legislation or company requirements make this mandatory. A space limitation did not allow of detailed treatment of crew complement and my article contrived to be technical rather than industrial in treatment. Reference was made, though, in the introduction to this subject.

2. Mr. Segall's accusation of naïvety in his parochially minded letter puzzles me. The application of the terminology "self-contained" to Doppler is purely a question of semantics, "airborne" might equally have applied. My endeavour was solely to differentiate between a ground-based system of propagation and one contained "within the airframe" independent of ground transmissions and non-reliant on any external agency (excepting, of course, the reflecting surface and heading "input" which I qualified).

3. A misquotation—I don't wish for monitors for *all* long-range navaids. However, general prudence, and any hope of international acceptance demands the highest reliability factor, or *failing this* the fail-safe provision of acceptable alternative systems.

4. Contrary to his assertion of ". . . housewives' naïvety regarding the claims of detergent properties . . ." pilots are generally cautious in any *carte-blanche* acceptance of the claims of a new electronic device until adequate opportunity for full assessment has been provided. This policy has been applied to every advance in the operational field, e.g., Zero Readers, airborne teletype receivers, auto-coupled ILS approaches, etc. Having proven their worth as regards reduction of cockpit workload, increased safety, or enhanced operational efficiency, we feel we are sufficiently progressive and broad-minded to give them a fair try-out in everyday operations, and industrial or political ramifications will naturally be considered alongside technical advantages.

Finally, if Mr. Segall is himself so naïve as to imagine that a future RAC/COM Division of ICAO would draw up a set of Standards (or even Recommended Practices) on Long-Range Navaid Requirements, to cover the inevitable small lateral separations and high speeds of the future based solely on a gyro-stabilized sextant, *assisted* by an all-weather drift meter (why not the computer), then I suggest he reads up some typical reports of previous Divisional Meetings in this field. (The report of the COM/OPS/RAC Division on short-range navaid requirements, or the report of the 2nd Air Navigation Commission of some years ago, which laid down preliminary long-range requirements.) He would then observe how adequately his "super sextant" might fit the bill! Alternatively a friendly natter over a pint with any oceanic controller, or one of the "non-stop" New York Airways controllers, might open his eyes to some of the facts of life air-traffic-density-wise!

London, W.1. S. M. B. LANE
(Member, IFALPA, RAC/COM Study Groups).

Groundabout

Wholly Writ. "You padres don't realize how lucky you are. The Chaplains Branch must be the only one in the whole Air Force which isn't continually plagued by amendments to its publications." In this connection, A.M. indicates not "Air Ministry" but "Ancient and Modern."

*

Line Shot

"The pilot was so stupid that even the navigator noticed."

*

Boost, my dear, Boost. Capt. K. F. Bainbridge, writing from his retirement after 15 years with B.O.A.C.: "I remember the new stewardess who, after listening to me land a Constellation at night, remarked 'Isn't it wonderful, he can judge 30, 28 and 24 inches above the ground at night!'"

*

"Look! No Wings!" That was the *Financial Times*' heading to their 130-word report about the USN pilot who "absent-mindedly" took off a "secret jet fighter" with its wings folded, found he could control it and brought it back to a safe landing at Naples Airport. A remarkable incident but what's financial about it? Let's muse on it—aircraft can fly without folded areas, obviously doesn't need them; O.K., don't have them, so, less material, less work, unemployment, shrinking industry, strikes, recession, Wall Street, Stock Exchange . . . h'm, I suppose there's *something* financial about it somewhere. . . .

*

Dept. of Nausea. Nobody could say this life of Pressmanship is without its moments. I've just been invited by Air Ministry to visit the R.A.F. Institute of Medicine to have a drink of Libyan snail-fluid. Highly recommended for aircrew who, as A.M. say, "for any reason might find themselves stranded in the desert."

by Gordon

Industry Record

Reconnaissance Equipment

Recent developments in aerial reconnaissance and photogrammetric equipment produced by the **Williamson Manufacturing Co., Ltd.**, include new cameras, a large scale plotter and the Blink stereoscopic projection system.

The latest model of the company's Type F.49 air survey camera is a 12 in. Mk. 3 equipment which differs from the 6 in. Mk. 2 camera in its optical unit. Containing a detachable shutter, the Mk. 3 optical unit is interchangeable with the earlier unit. A new magazine has also been developed for the F.49 camera containing sufficient film for 300 exposures; compared with 200 exposures with the standard magazine.

Two new models, C and E, have been added to the Williamson Type F.177 series of aircraft cameras. The F.177C is similar to the F.117B, but is specifically designed for remote control and permanent installation in an aircraft. A fixed mounting for the camera is also available.

The Type E is the latest of the F.117 series and is similar to the F.117B (hand-held and triggered with electric rewind) but contains an integral electric supply in the form of an ultra-lightweight battery. Due to weight savings elsewhere it weighs no more than the B model.

Another camera is the Type F.96, the standard R.A.F. reconnaissance unit which employs the principle of image movement compensation so that even when installed in high-speed aircraft the ground image is effectively stationary during exposure. The camera has interchangeable lenses of 6 in., 12 in., 24 in., 36 in., and 48 in., focal length and alternative magazines of 250 ft., 500 ft. and 1,000 ft. capacity. It is specifically designed for mounting as one of a bank of cameras but may also be used singly.

The Blink stereoscopic projection principle supersedes the colour filter system used in mapping in which a stereoscopic effect is provided by blue and red filters. The new system replaces the filters by continuously rotating shutters, one in each of the two projector heads, and two mounted side by side for viewing the two superimposed images. The shutters are matched in pairs (one head and one viewing shutter) so that one pair is open when the other pair is closed. Thus each viewing shutter receives light from one projector only. This, the company states, achieves the image separation equivalent to colour filters without the loss in light and with a cleaner separation than the standard system.

Research and Development Office

The **Northern Research and Engineering Corpn.** of Cambridge, Massachusetts, has opened an applied research and product development office in London.

This company conducts both research and development and industrial consulting in heat transfer, thermodynamics, fluid mechanics and related technical marketing. A large portion of its work has been concerned with environmental conditioning and auxiliary power systems for aircraft, missiles and space vehicles. The company also performs work for a number of diverse industries, such as chemical processing, engines and electronics.

A.W.E.-Avery Agreement

Armstrong Whitworth Equipment in conjunction with **Avery-Hardoll** have completed their agreement covering refuelling couplings for general aircraft use and wish to advise all customers that the Armstrong Whitworth sales promotion of these particular couplings has now come to an end. As a result of this, Avery-Hardoll will undertake again the sale of their refuelling couplings and, in consequence, no future orders will be accepted direct by Armstrong Whitworth Equipment.

New BEAMA Section

The British Electrical and Allied Manufacturers' Association has established a **Semi-Conductor Devices Section** in recognition of the rapid technical advance in semi-conductors and their increasing application for power and industrial purposes.

The formation of this section will provide within the Association an expert body to guide manufacturers of semi-conductor devices on matters of industrial policy. It will co-operate closely with the Valve and Semi-Conductor Association, and among the important objectives will be the work of fostering standardization of semi-conductor devices, both on a national and international basis.

Mr. L. E. Thomson, director and manager of the Rectifier Section, Westinghouse Brake and Signal Co., Ltd., is the chairman of the section, and its initial membership includes Associated Electrical Industries, English Electric, Ferranti and Standard Telephones and Cables.

PUBLICATIONS RECEIVED

Fabrication des Avions et Missiles.—By M. P. Guibert (French text). 468 pp.; 7½ in. by 11 in. Illustrated. Dunod, Paris.

They Fought for the Sky.—An account of the War in the air, 1914-1918, now issued as a paperback. By Quentin Reynolds. 288 pp.; 4½ in. by 7 in. Illustrated. Pan Books, Ltd. Price 3s. 6d.

Modern Flight III.—A guide to flying for pilots, covering basic, aerobatic, multi-engine and instrument flight. By Cloyd P. Clevenger. 304 pp.; 5½ in. by 8¼ in. Illustrated by Clayton Knight. Floyd Clymer (1268 South Alvarado Street, Los Angeles, 6). Price $3.

Deterrent or Defence.—A study of the strategic situation today, with reference to "the fading deterrent" and some suggested alternatives. By B. H. Liddell Hart. 168 pp.; 5½ in. by 8¾ in. Stevens and Sons, Ltd. Price 30s.

Aviation Calendar

Aug. 20

London.—Science Museum lecture, "The Story of Flight," by Victor Wall, in the Science Museum, Exhibition Road, S.W.7, at 15.15 hrs.

Stockholm.—11th International Astronautical Congress; closes Aug. 20.

Aug. 27

Luton Airport.—Luton Flying Club Aerial Day, at 15.00 hrs.

Aug. 29

London.—European Congress of Aviation Medicine on "Human Problems of Supersonic and Hypersonic Flight"; until Sept. 2.

Sept. 1

London.—Society of Instrument Technology and British Interplanetary Society Symposium on "Rocket and Satellite Instrumentation," at Manson House, 26 Portland Place, W.1.

Sept. 5

Farnborough.—S.B.A.C. Air Show; until Sept. 11.

Sept. 8

Varenna, Italy.—AGARD and Lomard Institute of Science and Letters seminar on "Propulsion for Astronautics"; until Sept. 12.

Sept. 9

Cranfield.—International Rally organized by the Popular Flying Association; until Sept. 12.

Sept. 14

London.—Ultra Anniversary lecture, "The Evolution of Instrumentation," by Prof. A. Porter, in the Recital Room, Royal Festival Hall.

Sept. 16

Oxford.—Institute of Transport Week-end Course at New College; until Sept. 19.

Sept. 27

London.—The Institution of Mechanical Engineers Symposium on Automatic Control; until Sept. 28.

Company Notices

CHANGE OF NAME

Harold Bamberg (Holdings), Ltd. (561,051), 12 Low Pavement, Nottingham.—Name changed to British Eagle International Airways, Ltd., on Feb. 11, 1960.

New Patents

APPLICATIONS ACCEPTED

849,851.—**Goodrich Co., B.F.**—"Fast response temperature-responsive electric switch."—May 7, 1958 (May 9, 1957).

850,042.—**Curtiss-Wright Corporation.**—"Apparatus for loading a simulated aircraft rudder pedal control in ground flight training apparatus."—Jly. 4, 1958 (Jly. 17, 1957).

850,012.—**Power Jets (Research and Development), Ltd.**—"Deflection of fluid jets."—Aug. 22, 1957 (Aug. 23, 1956).

850,060.—**Doak Aircraft Co., Inc.**—"Flight control systems on aircraft."—Oct. 9, 1958.

850,103.—**Recherches Etudes Production R.E.P.**—"Control systems for aircraft."—Dec. 20, 1957 (Jly. 12, 1957, and Oct. 29, 1957).

850,124.—**Short Bros. and Harland, Ltd.**—"Fluid-pressure reciprocatory motors."—May 4, 1959 (May 5, 1958).

849,496.—**Folland Aircraft, Ltd., Constant'ne, A., and Marsh, J.**—"Aircraft ejector seats and canopy releases."—Dec. 24, 1957 (Sept. 24, 1956).

849,555.—**Kostelezky, W.**—"Method for the manufacture of hemispherically shaped parachutes made of tapes, and parachutes so manufactured."—Sept. 14, 1956.

849,535.—**General Electric Co.**—"Hypersonic flow generators."—Mar. 10, 1958 (Mar. 11, 1957).

849,912.—**Goodyear Tire and Rubber Co.**—"Airplane landing gear."—Nov. 5, 1956 (Apr. 6, 1956).

849,964.—**De Guerra, M. T.**—"Aircraft landing wheels."—Nov. 20, 1958 (Dec. 2, 1957).

849,985.—**Rotol, Ltd.**—"Aircraft undercarriages." Dec. 15, 1958 (Dec. 13, 1957).

849,350.—**Power Jets (Research and Development), Ltd.**—"Aircraft."—Oct. 7, 1958 (Oct. 16, 1957).

849,448.—**Rolls-Royce, Ltd.**—"Nozzles for jet propulsion purposes."—Mar. 17, 1958 (Mar. 22, 1957).

849,850.—**Rolls-Royce, Ltd.**—"Aircraft jet propulsion apparatus."—Feb. 11, 1959 (Mar. 31, 1958).

Printed specifications of the above will be available on Sept. 28, 1960, and the opposition period will expire on Dec. 28, 1960.

Personal Notices

BIRTHS

Clifton.—On Jly. 30, at U.S.A.F. Hospital, Offutt, Nebraska, to Joyce, wife of Sqn. Ldr. P. J. Clifton—a daughter.

Hilton.—On Aug. 4, at R.A.F. Hospital, Cosford, to Jenny (*née* Butler), wife of Flt. Lt. A. P. Hilton—a daughter.

Keats.—On Jly. 30, at Coltishall, to Barbara (*née* Sears), wife of Sqn. Ldr. D. J. B. Keats—a daughter.

Magor.—On Aug. 1, at R.A.F. Hospital, Wegberg, B.F.P.O. 40, to Miriam (*née* Sinnott), wife of Sqn. Ldr. D. H. Magor—a daughter.

Traverse.—On Aug. 2, at R.A.F., Jever, Germany, to Pat, wife of Flt. Lt. A. J. Traverse—a daughter.

Williams.—On Aug. 4, at P.M.R.A.F. Hospital, Halton, Bucks, to Mary, wife of Flt. Lt. Alun Williams—a son.

MARRIAGE

Atkinson-Turner.—On Jly. 30, at St. Joseph's R.C. Church, Havant, Flg. Off. A. J. Atkinson to Plt. Off. P. A. Turner, W.R.A.F.

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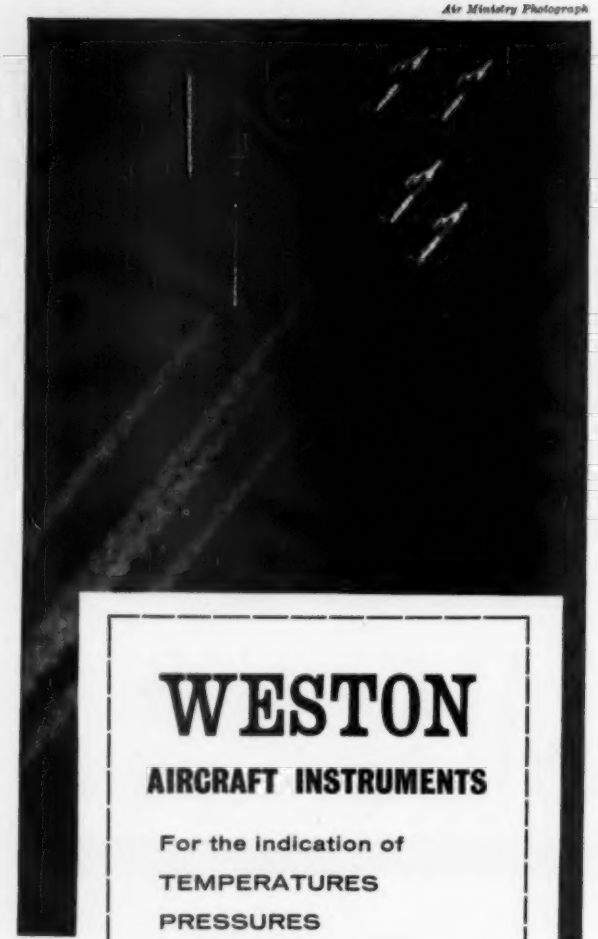

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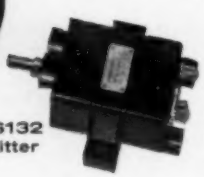

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL.

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM EAST ANGLIAN FLYING SERVICES, LTD., OF SOUTHEND AIRPORT, ESSEX, for the following Normal Scheduled Services for the carriage of passengers, supplementary freight and mail at a frequency of two return flights weekly on each service, for 10 years from January 1, 1961:—

APPLICATION NO. 4438, initially with Viking and Dakota aircraft and later also with Ambassador aircraft, on the route Birmingham and/or Southend-Basle.

APPLICATION NO. 4439, initially with Viking and Dakota aircraft and later also with Heron and Herald aircraft, on the route Birmingham and/or Southend-Lyons-Albenga, increasing to six return flights weekly from June to September each year.

FROM AIR SAFARIS, LTD., OF GATWICK AIRPORT, HORLEY, SURREY:—

APPLICATION NO. 3358/1 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate between Bournemouth (Hurn) and Dublin with Viking aircraft at a frequency of two return flights weekly until June 30, 1963, so as to enable them to operate on the amended route: Bournemouth (Hurn)-Dublin and/or Belfast, and to increase the frequency according to traffic demand.

FROM TRADAIR, LTD., OF SOUTHEND AIRPORT, ESSEX:—

APPLICATION NO. 4442, for an All Freight Service with Viking aircraft, on the route Southend and/or Marseilles and/or Malta, at an initial frequency of eight return flights monthly, increasing later to one return flight daily, for seven years from October 1, 1960.

FROM BRITISH UNITED AIRWAYS, LTD., OF 35 PICCADILLY, LONDON, W.1:—

APPLICATION NO. 98/7 for permission for their associate company Transair, Ltd., to operate in 1961, during the extended season from June 3, to September 30, on the U.K. Internal Service which they are at present authorized to operate with Viscount aircraft, on the route:—

London (Gatwick)-Guernsey and/or Jersey, at a frequency of three return flights weekly on Fridays and Saturdays from mid-June to mid-September each year, until September, 1966.

FROM BRITISH EUROPEAN AIRWAYS OF BEALINE HOUSE, RUISLIP, MIDDX:—

APPLICATION NO. 392/2, for permission to operate at a frequency in accordance with traffic demand on the following Normal Scheduled Services (except where otherwise stated), and to operate with Comet, Vanguard and DH.121 aircraft in addition to the aircraft at present authorized:—

London Airport-Frankfurt (opt.)-Munich (opt.)-Salzburg (Application No. 392).

All Freight Service on the route: London Airport-Frankfurt (opt.)-Dusseldorf (Application No. 425).

London-Milan-Athens-Cairo (opt.)-Istanbul (opt.) Apolication No. 439). London Airport-Dusseldorf and/or Munich and/or Zurich or Geneva and/or Vienna-Belgrade-Athens (opt.)-Instanbul (opt.)-Cairo (opt.) (Application No. 703).

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 548-6

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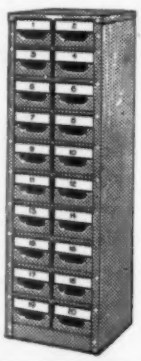

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DAN-AIR ENGINEERING, LTD., has vacancies for suitably licensed engineers for base engineer duties. Apply: Chief Engineer, Lasham Airfield, Nr. Alton, Hants. 549-9050

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Particulars and application forms (stamped addressed foolscap envelope) from AIRPORT DIRECTOR, MANCHESTER AIRPORT, WYTHENSHAWE, MANCHESTER 22, returnable by August 30, 1960. 548-4

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APPLY:—
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SKYWAYS, LTD.,
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LONDON AIRPORT NORTH. 548-1

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CARE OF THE AEROPLANE AND ASTRONAUTICS. 548-8

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WANTED, two Dakota licensed engineers "A" and "C" willing to fly as flight engineers when required. Apply, Derby Aviation, Ltd., Derby Airport, Derby. 550-9053

FIELD AIRCRAFT SERVICES, LTD., at London Airport, have vacancies for licensed supervisors and inspectors, aircraft electricians and engine and airframe fitters. Please apply in writing to the Works Superintendent. 548-11

CITY OF LIVERPOOL

APPOINTMENT OF

AIRPORT DIRECTOR.

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Further particulars and application forms, returnable by September 2, 1960, may be obtained from me Canvassing disqualifies.

THOMAS ALKER,
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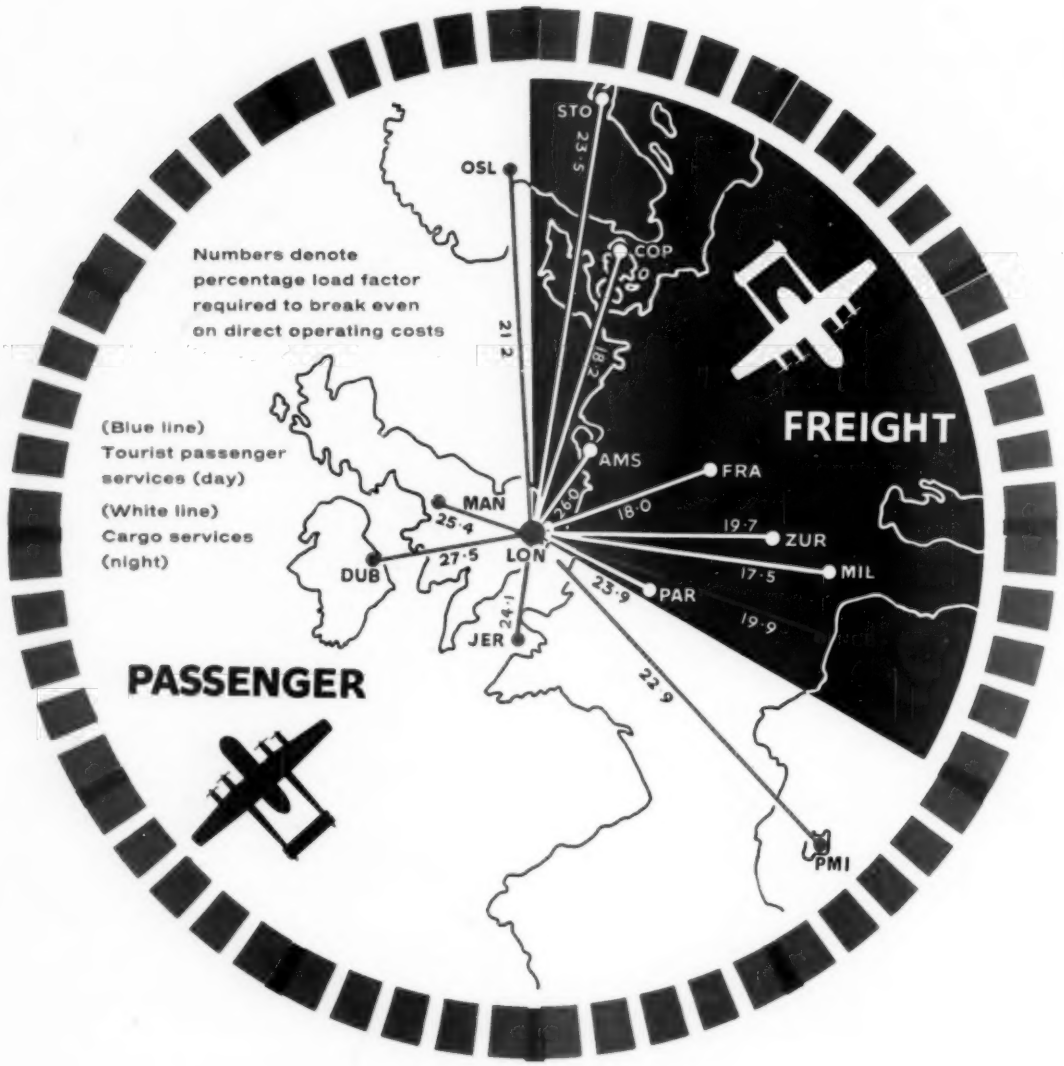

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